THE Petroleum Engineer

NOVEMBER 1934

VOLUME VI NUMBER II

A MAGAZINE OF METHODS FOR OPERATING MEN

This Issue Contains

DRILLING AND PRODUCTION

	Page
Some Economic Aspects of Gas Solubility Investigations — By Alexander B. Morris	45
Elements of Applied Petroleum Production — By K. C. Sclater	129
Anti-Friction Bearings in Oil Field Equipment — By Otto Neumer	158
Reducing Underreamer Costs	162
Core Drill Completes 35 Oil Structure Holes in Three Months	165

REFINING AND NATURAL GASOLINE MANUFACTURE

Refinery Economics (Article 2) — By W. L. Nelson	52
Safety Vent for Fractionator Outlet in Gasoline Plant — By J. C. Albright	58
Light Translucency of Thin Adsorbed Films of Lubricants (Article V) — By S. Fischer, Jr., and Edward Marinoff	61
Lubricated Plug Valves in Refinery Service — By G. F. Scherer	72
Elements of Applied Petroleum Refining — By W. L. Nelson	133

OIL AND GAS TRANSPORTATION

Pipe Line Bridge With Unsymmetrical Suspension Span — By Wilder Kenan	43
Elements of Applied Petroleum Pipe Line Transportation — By Emory Kemler and L. L. Thomas	138
The Internal Corrosion of Natural Gas Transmission Lines — By Elmer F. Schmidt and Thomas S. Bacon	168

GENERAL

Simple Pipe Arrangement for Utilizing Exhaust Steam — By W. F. Schaphorst	51
Accuracy of Pitot Tube Measurements Near Points of Disturbance — By Edward M. Rauh	66

ARTICLES APPEARING IN SPECIAL DALLAS SECTION

	Page
Dallas — Geographical Center of the Mid-Continent Oil Industry	D-4
Dallas — As a Distributing Center	D-11
Dallas — As a Manufacturing Center . . Its Office Facilities	D-13
Dallas — As a Financial Center	D-19
Dallas — As a City in Which to Live	D-22

ARTICLES APPEARING IN SPECIAL CALIFORNIA SECTION

Los Angeles Is Logical Meeting Place for the American Petroleum Institute in 1935 — By C. S. Jones	C-12
California's Oil — From Brea Beds to Record Depth Production — By Wallace A. Sawdon	C-17
California Crude Oil Production — By Thomas H. Sherman	C-36
California Contributes Much to Drilling and Production Practices — By Wallace A. Sawdon	C-46

REGULAR DEPARTMENTS

The Course of Oil	9
Highlights in Oildom	10
Latest Activities in the Oil Fields	12 and 13
Progress of Major Pipe Line Work	14
The Month's Activities in Refining	16
Trade Literature	70
Book Reviews	127
Running Tour With Men in the Industry	144
New Petroleum Equipment	146, 148, 150, 151 and 152
Laugh With Barney	154
Strange But True	157

COPYRIGHT—Each issue of The Petroleum Engineer is copyrighted. Any republication of the matter appearing in the magazine, either wholly or in part, is not permitted except by special authorization.

SUBSCRIPTION PRICE—Single copies 15 cents. Domestic and foreign, $1.00 per year, three years $2.00, with the exception of Canada, where the price is $1.65 per year, three years $3.95.

THE PETROLEUM ENGINEER PUBLISHING COMPANY

Tower Petroleum Building

DALLAS, TEXAS

NEW YORK CITY

T. J. CROWLEY
Vice-President and Eastern Manager
101 Capitolian Blvd.
Rockville Center
Long Island, N. Y.

C. MORRIS — *President-General Manager*
J. L. DWYER — *Vice-President*
W. T. BRYAN — *Secretary-Treasurer*
W. L. LOVE — *Vice-President and Adv. Mgr.*
C. R. BARRETT — *Circulation Manager*
K. C. SCLATER — *Editor*
FRANK H. LOVE — *Associate Editor*

TULSA, OKLA.

K. J. LANGLEY
Mid-Continent Advertising Representative
1708 South Utica St.

MEMBER A. B. C.

NRA MEMBER U.S. WE DO OUR PART

MEMBER A. B. P.

"HERCULES" RED-STRAND

REG. U.S. PAT. OFF.

WIRE LINES

An Acid Steel Product, Every Wire of Which Is Rigidly Tested to Insure Highest Quality

You men who are responsible for drilling and production costs know how expensive unexpected wire rope failures are. You also know that the work is hard, and that sturdy lines are required to stand the gaff.

"Hercules" **(Red-Strand)** Wire Rope is in high favor wherever used because of its remarkable stamina and sturdiness. It is dependable. There are reasons for this, of course, for quality is never a matter of guess or luck. It is always the result of definite purposes and actions, and so it is with all Leschen Wire Lines.

Another important factor is that "HERCULES" **(Red-Strand)** Wire Lines are furnished in a wide range of constructions as we have found that no one type of wire rope is suitable for all oil field purposes. There are "HERCULES" rotary lines, cable-tool lines, casing lines, sucker rod lines, swabbing lines and tubing lines.

After all, results in the field are what count, and we offer for your consideration the actual service record of these wire lines. Why not give them a chance to show you what they can do? Do not hesitate to try them on your hardest work.

THE WIRE ROPE WITH THE SERVICE RECORD

Made Only by A. Leschen & Sons Rope Co. **Established 1857**

5909 Kennerly Avenue . . . St. Louis, Mo.

New York . . . . . 87 to 90 West Street
Chicago . . . . . 810 West Washington Blvd.
Denver . . . . . 1554 Wazee Street
San Francisco . . . . . 520 Fourth Street

Domestic Distributors:

CASEY & NEWTON
901 Century Building
Pittsburgh, Pa.

HILLMAN-KELLEY, Incorporated
2441 Hunter Street
Los Angeles, Calif.

HINDERLITER TOOL COMPANY
Tulsa, Oklahoma

NORVELL-WILDER SUPPLY COMPANY
Beaumont, Texas

OSBORN MACHINERY COMPANY, Inc.
Clarksburg, W. Va.

PARKERSBURG SUPPLY COMPANY
Parkersburg, W. Va.

UNION PIPE AND SUPPLY COMPANY, Inc.
Owensboro, Kentucky

UNITED PIPE AND SUPPLY CORPORATION
Charleston, W. Va.

Export Distributor:

CONTINENTAL EMSCO CO., Inc., Room 4337, No. 30 Rockefeller Plaza, New York City
Branches: Buenos Aires - London - Ploesti

The Course of Oil

By K. C. SCLATER

Three Points of Interest

Three important points of interest that are likely to have some bearing on the immediate future of petroleum will claim the attention of the industry during November. First, there is the new regime for enforcing control of production in the East Texas field; second, there is the annual meeting of the American Petroleum Institute at Dallas; and, third, there are the field hearings of the Congressional Committee appointed to report on the oil industry.

Under the new control enforcement program recently put into effect in East Texas an auspicious beginning really seems to have been made at last by Federal officials to end illegal production. Though a collapse in crude prices has been averted it would be premature at this time to pass judgment on the permanency of the results. Numerous false starts to enforce control in this field have made the industry skeptical. Heretofore, legal barriers that apparently could not be successfully hurdled have stood in the way of enforcement. These obstacles appear to have been removed. Only time will disclose the full efficacy of the measures taken.

A comprehensive schedule of topics on almost every operating phase of the oil industry is up for discussion at the Dallas meeting of the American Petroleum Institute. Will the views of the many leaders, when brought together, be crystallized into some code of action to maintain the improvement already noted in the industry? Will a more united front be apparent, or will there still be widely divergent views between the factions for and against Federal control in the industry? These are all pertinent questions affecting the immediate future of petroleum.

What course the field hearings of the Congressional Committee will take is problematical. It is certain, however, that the information obtained at these hearings will be a deciding factor in determining what course, if any, the Government may see fit to take with respect to closer control of petroleum resources.

Research and Its Application in Practice

Last month in Tulsa at the fall meeting of the Petroleum Division of the A.I.M.E., several papers were presented on gas solubility and related subjects appertaining to underground conditions in oil fields. Petroleum engineers are evincing greater interest in the fundamentals of reservoir control of oil and gas fields; for it is becoming more widely recognized that development and producing operations governed chiefly by a consideration of reservoir conditions, make for greater economic recovery.

Despite this display of interest in the fundamentals of reservoir control, it is a sad fact that frequently the results of theoretical investigations involving underground conditions in oil fields are just abstruse enough that their practical significance is lost to the average field engineer. All too often he is too fully occupied with routine problems of operation to permit him to cogitate very deeply on research investigations and enable him properly to appraise their practical possibilities. The consequence is that the application of valuable information to the solution of practical field problems is frequently delayed months, or even years, and possible economic gains thereby overlooked. In this connection, attention is drawn to one of the papers published on page 45 of this issue, wherein the author suggests a wider use of available theoretical knowledge to practical ends in the interest of economy and efficiency.

In the matter of bottom-hole data alone, it has been observed that if the importance of the information in regard to practical phases of producing operations that may be obtained from complete analysis of bottom-hole samples were more fully realized, companies would do much more of this work than is done at present. The information yielded by routine field studies of bottom-hole data is an invaluable guide in conducting practical field operations.

Water-Drive Theory in East Texas

Operations in East Texas are yielding an increasingly valuable storehouse of technical information. The very fact that it has been necessary to shut down the field completely on several occasions has been instrumental in providing valuable engineering data on oil field reservoirs. Building up of bottom-hole pressure during these shut-downs has caused much speculation in regard to the nature of the water-drive in the field. Studies on shrinkage of the oil made on bottom-hole samples taken under pressure indicate that, if the building up of pressure were to be attributed solely to the expansion of the oil in the reservoir in areas of depleted pressure in the field, the average reservoir pressure would have dropped to 740 lb. by the time the field had produced 70,000,000 bbl. of oil. Research studies of pressure data, of the general reservoir conditions, and the analyses and tests of bottom-hole samples, indicate that to date most of the expulsive energy has probably been derived from water-drive. This finding is based on the theory of progressive expansibility of the water in the Woodbine sand. According to this theory, it is assumed that the water undergoes expansion as the pressure is released. The amount of expansion will be in proportion to the decrease in pressure and also will depend on the amount of gas and salt in solution in the water. Thus the expansion of the water will be progressively greater as the oil horizons in the reservoir are approached, and likewise will decrease away from the reservoir. It has been demonstrated that in the East Texas field there is an optimum rate of production that will result in the greatest utilization of energy derived from water-drive.

This theory, which throws new light on the mechanics and importance of a natural water-drive, may find useful application in many other oil fields.

« « « HIGHLIGHTS IN OILDOM » » »

Collapse of Crude Market Averted

Following several days of anxiety, during which it was feared that the crude price structure might topple, oil men are breathing more easily and it appears that the danger has been averted. The Atlas Pipe Line Co., which on October 23 reduced its paying price for East Texas crude to 60 cents per bbl., on October 31 again posted a price of $1 and made it retroactive to October 23. Several independent purchasers in various parts of the Mid-Continent who followed the Atlas' lead in cutting prices were expected to follow the advance also. The major companies made no reduction in quotations at any time.

Some of the buyers who dropped their posted price on crude stated they took such drastic steps in an effort to force immediate action on the part of Federal and state governments to "correct flagrant abuses in the industry," meaning the hot oil situation in East Texas. If such was the intention it had the desired result. The Federal government jumped into the hot oil picture in a vigorous manner. Secretary Ickes named a federal tender board to pass upon East Texas tank car shipments out of the state, resulting in curtailing immensely the movement of illegally produced crude. L. R. Martineau, Jr., special attorney general of the United States, was hurriedly dispatched from Washington to Texas when a crash of the crude price structure seemed imminent. Since his arrival at Tyler, headquarters of the "hot oil" forces, several injunctions have been issued against refineries, restraining them from overproduction. One such injunction against seven East Texas refineries was set for hearing November 2, in the Federal Court at Beaumont, but was subsequently transferred to the United States District Court at Tyler by order of Federal Judge Randolph Bryant and the date for the hearing moved up to November 17.

The Texas Railroad Commission, oil regulatory body of the state, also has been invoking its powers to assist in controlling the situation. Officials of that agency are at work preparing an order stopping intrastate truck transportation of oil and refined products. In addition the pipe line division of the Railroad Commission has announced that it will sue for severance of pipe line connections to oil wells of all operators who fail to file monthly production reports. Three hundred operators were ordered deprived of outlets for failing to file September reports by October 15, and more than 60 per cent immediately filed the required reports, regaining their connections.

●

May End Proration in Simpson at O. C.

The Simpson below Wilcox sand zone of the Oklahoma City field may be taken from the list of prorated areas in December. Umpire W. J. Armstrong has made such a recommendation to the Oklahoma Corporation Commission. He suggested the wells be allowed to flow at capacity during November to test their potential.

Most of the Simpson wells are making large amounts of water, and with few exceptions every lease is producing its capacity under the order limiting the flow to a portion of its potential, engineers say.

It is estimated that, if permitted to flow at capacity during November, daily production would not total more than 35,000 bbl., whereas the present daily allowable is 32,000 barrels. Any overproduction would be made up in December, it is stated, and the open gauge of the wells would provide the figure upon which allowables would be determined for future months.

Loophole in Texas Oil Enforcement Laws

As the result of a loophole found in the Texas oil enforcement laws, passage of a bill has been suggested by Representative R. J. Long of Wichita Falls providing for a 50c to $1 penalty on each bbl. of hot oil produced, and also on products refined from illegally-produced crude. Opposition to the proposed bill has developed on the part of some oil men who fear it would be discriminatory and therefore unconstitutional. Members of the legislature and a group of oil men met in Austin early this month and it was thought action might be taken on Representative Long's proposal at that time. However, in face of the opposition it may be nothing will be done on that particular proposal until the regular session of the legislature.

The need for such a law seemed apparent when the state attorney general's department ruled that a trial court properly may order the issuance of a tender covering hot oil for the production of which the operator has been assessed a penalty by the court.

The present statute makes $1,000 per day the maximum fine to which an operator is subject for producing illegal oil. The ruling grew out of an application for tender on 80,000 bbl. of oil produced in eight days, with the producers pleading guilty to overproduction and being fined $500 per day, or $4,000. The state commission tender committee refused to issue a tender to move the oil, but the court ordered the commission to issue such a tender after payment of the fine, which amounted to 5 cents per barrel.

●

New Orders Governing Winkler Field

The Texas Railroad Commission on October 25 issued certain orders which it considers advisable for the prevention of crude oil waste in the Winkler field. One portion of the order makes it permissible for operators to equip their wells with large volume pumps with large diameters. The order states, however, that in no case where these pumps are used shall a well be permitted to produce more oil than is allocated on the basis of its unit allowance based on 20 bbl. minimum per well for the number of wells on that unit, plus the allowable based on its per cent potential as set out on the proration schedule for the Winkler field immediately before the installation of the large volume pumps.

The commission also has ruled that the one per cent decline by months of the potential of wells in the field shall remain in effect, but in no case shall the allowable of a well be reduced below the marginal allowance of 20 bbl., as set forth in a previous order issued by the commission.

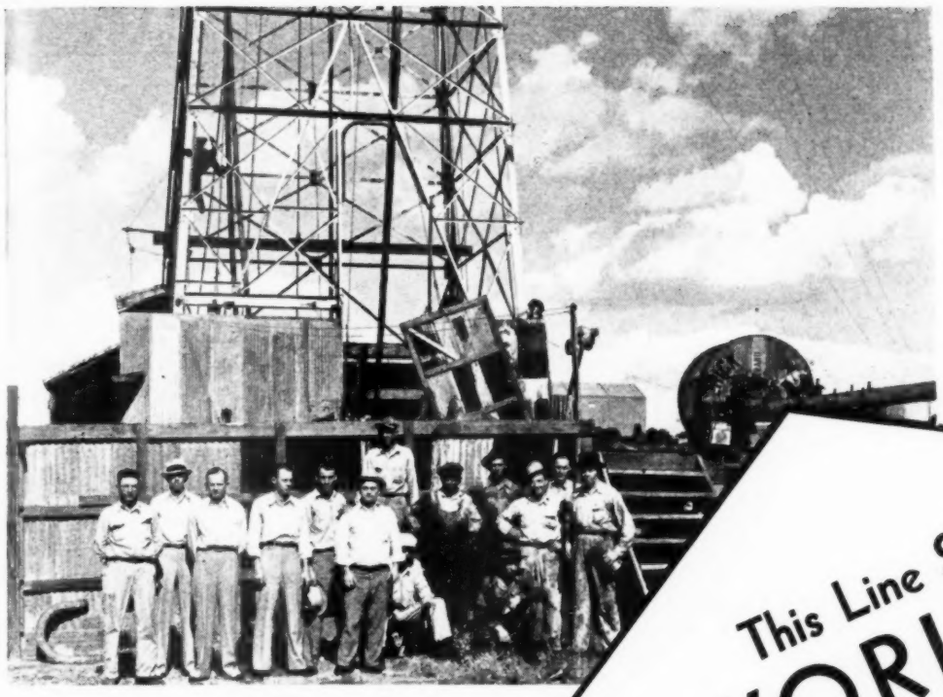
●

Decline Ruling Before Supreme Court

Attorneys for the Oklahoma Corporation Commission have asked the State Supreme Court to affirm a ruling of the commission permitting oil operators to accept a 50 per cent decline in production instead of submitting to open flow potential tests. The commission's order affected only wells in the Wilcox zone of the Oklahoma City field.

The I. T. I. O. Company has attacked the commission's order in the Supreme Court, contending the 50 per cent stipulation works a hardship on operators whose wells already have been tested for potential. The company is asking that the decline be increased to approximately 65 per cent.

State proration attorneys have filed lengthy briefs supporting the 50 per cent decline stipulation.



"Flex-Set" Preformed Yellow Strand Rotary Drilling Line helped make history at Gulf Production Company's No. 103 McElroy. In 19 hours, without a hitch, this 1⅛-in. line ran and landed 10,301 feet of 7⅝-in., 34-lb. casing—THE LONGEST STRING OF CASING OF THIS SIZE EVER RUN.

"Flex-Set" Yellow Strand has all the makings of a record-breaking rope. It is your old friend, Yellow Strand—preformed, limbered up, made easier to handle, quicker to install, easier to break in, smoother to operate—and longer lasting than ever. Try it. Save Money.

This Line Set
WORLD'S RECORD
String of 7⅝-in., 34-lb.
CASING
10,301 FEET

NRA MEMBER U.S. WE DO OUR PART

Broderick & Bascom Rope Co.
St. Louis
Factories: St. Louis and Seattle

THE CONTINENTAL SUPPLY CO.
Mid-Continent and Rocky Mountain Distributor

MURRAY-BROOKS HARDWARE CO.
South Louisiana Distributor

S-5

"Flex-Set" Preformed Yellow Strand Rotary Drilling Lines

LATEST ACTIVITIES IN THE OIL FIELDS

THICK sand bodies cored in the few tests drilled to the producing horizon in the new Sam Fordyce field of Hidalgo County, Texas, lead oil men to believe that the per-acre recovery there will be exceptionally large. A number of operations are in progress, and early this month the sixth producer was completed. Expectation of a large future output from the field is evidenced by the fact that operators are providing facilities on a large scale to handle the crude.

●

The Fitts pool of Pontotoc County, Oklahoma, has been given a southwestern extension. No. 1 Norris of Jack C. Shaffer and Associates was brought in on October 30, making 195 bbl. per hour, and producing from the Bromide sand at a total depth of 4250 feet. This is the eighth producer for the area.

●

No. 1 Yetcha of the Burke-Gries Oil Company, located in the Wapanucka-Cromwell area of the Fish pool, Oklahoma, has extended that sector north into the Holdenville pool area. Casing was set on top of the producing sand at 3005 ft., and when the plug was drilled into the sand the well produced 720 bbl. of oil the first 24 hours.

●

The record of the Union Sulphur Company's Barbee Estate No. 2, which recently opened a new pool six miles northeast of Lake Charles, Louisiana, gives indications of a promising field in that area. The well lately has been producing approximately 170 bbl. of 31.4 gravity oil daily, an increase over its initial flow. The well originally was drilled below 7900 ft., but a lost bit caused the operators to plug back and sidetrack at 6631 feet. The well was then drilled in the sidetracked hole and is producing from the sand at 6750-6760 feet.

●

The Edison Oil Company's No. 1 Fairchilds, completed recently in the new Edison field of Kern County, California, is arousing considerable interest in that district. It was drilled to a total depth of 3637 ft. and is producing approximately 2400 bbl. of 28.8 gravity oil daily, together with 300,000 cu. ft. of gas. This is the first producer completed in the deep zone of the field that would flow.

●

A new pool has been opened in Hutchinson County, Texas, northwest of the Canadian River by the Humble Oil and Refining Company. That company's No. 1 Logan, a wildcat, was plugged back from 3296 ft. after drilling into water, to be completed in the upper pay found at 2190-3216 feet. At that depth the hole filled to a depth of 1200 ft. with oil and at 3215-3220 ft. showed an increase. It is estimated as a 100-bbl. well.

●

A drilling operation has begun on the John Rynd farm near Rouseville, Pennsylvania, the first on this property in five or six years. The property is one of the oldest in the country, Rynd's great-great-grandfather having obtained it in 1800 on a patent from the government, and the land has been in possession of the family ever since. There are approximately 125 wells on the 250-acre tract. This operation is the first step in repressuring on the property.

●

Geological surveys are being made in the Carpathian oil fields of Poland to determine the practicability of new drilling. This exploration work is conducted with apparatus recently imported from the United States and Sweden. New drilling has been undertaken so far this year in the districts of Brzezina, Derzow, Kijowiec, Mikolajow, and Rozwadow in the Zydaczow region, and in Grabowska, Niebylow, Petranka, and Sloboda Niebylowska in the Kalusz region.

●

A large expenditure of British capital will be involved in the exploitation of the new Persian oil field known as Naft-i-Shah by the Anglo-Persian Oil Company, it is announced. The oil field is a few miles from the Iraq frontier in the neighborhood of the town of Khanaquin. Crude will be transported through a pipe line more than 100 miles long to Kermanshah, where a refinery is being constructed. From Kermanshah the gasoline and other products will be distributed to all parts of Northern Persia.

AVERAGE CRUDE OIL PRICES

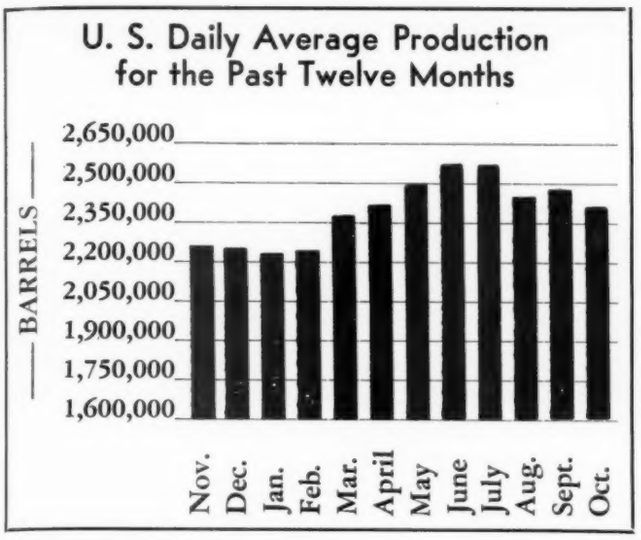
California		Louisiana	
Playa Del Rey	$ .90	North Louisiana	$ .95
Coalinga	.81	Gulf Coast	1.04
Signal Hill	1.12	Illinois	1.12
Montana	1.35	Kentucky	1.17
Wyoming	1.00	Indiana	1.12
Colorado	1.00	Ohio	
New Mexico	.75	Lima	1.30
Texas		Michigan	1.02
North Central	.95	Pennsylvania	
Panhandle	.83	Bradford	2.55
West Texas	.70-.75	Southwest	2.22
Gulf Coast	1.04	Eureka	2.17
Darst Creek	.87	Buckeye	2.07
East Texas	1.00	West Virginia	2.07
Kansas	1.00	Canada	2.10
Oklahoma	1.00		
Arkansas	.70		

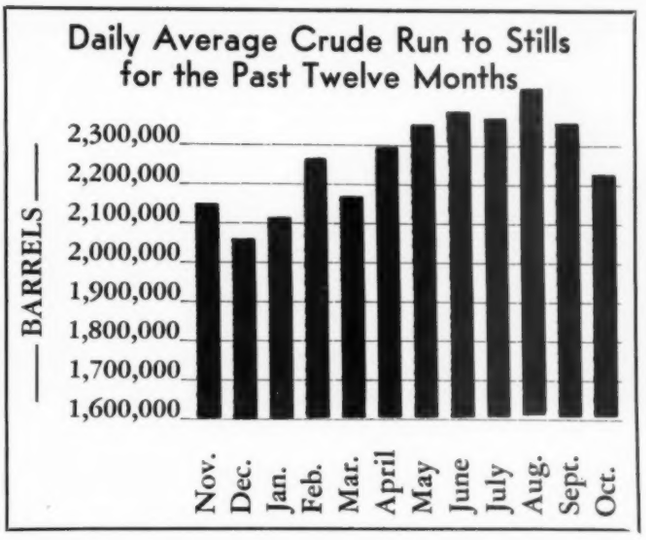
DAILY AVERAGE CRUDE OIL PRODUCTION

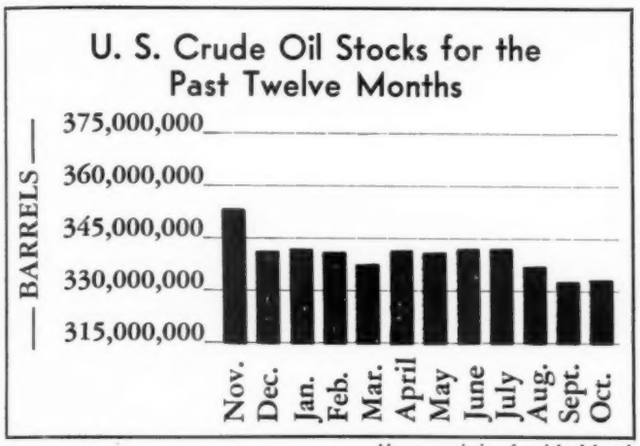
(Figures in barrels)

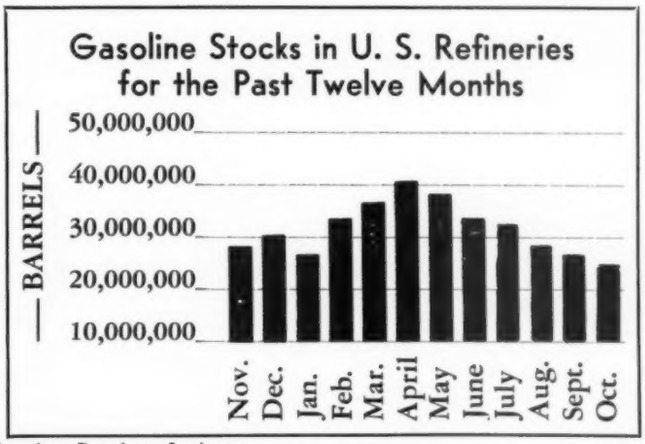
Furnished by A.P.I.

	Federal Agency Allowable Effective Oct. 1	Week Ended Oct. 20, 1934	Week Ended Sept. 29, 1934	Week Ended Oct. 21, 1933
Oklahoma	457,400	480,400	451,200	519,800
Kansas	127,700	123,650	122,150	114,300
Panhandle Texas		54,750	61,600	47,100
North Texas		57,300	59,050	56,400
West Central Texas		27,500	27,850	23,500
West Texas		139,050	157,250	126,150
East Central Texas		42,650	52,150	45,300
East Texas		401,600	427,050	482,000
Conroe		38,200	47,300	74,450
Southwest Texas		59,500	57,700	49,350
Coastal Texas (Not incl. Conroe)		125,750	131,050	112,400
TOTAL TEXAS	956,100	946,300	1,021,000	1,016,650
North Louisiana		23,900	23,900	25,950
Coastal Louisiana		71,850	75,450	47,900
TOTAL LOUISIANA	88,300	95,750	99,350	73,850
Arkansas	30,200	30,650	31,250	32,950
Eastern (Not incl. Michigan)	97,300	104,200	104,200	98,900
Michigan	29,000	30,900	33,500	29,250
Wyoming	33,900	35,100	38,950	30,450
Montana	8,800	11,600	11,500	6,450
Colorado	3,000	3,050	3,450	2,400
TOTAL RK. MT. ST.	45,700	49,750	53,900	39,300
New Mexico	45,800	45,550	46,850	42,000
California	452,300	472,500	438,700	467,500
TOTAL U. S.	2,325,800	2,379,650	2,402,100	2,434,500









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for October, 1934

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	299	292	30	243	3600	2	40	Rotary
Duval County	30	27	3	7	2300	2	22	Rotary
Archer County	57	25	19	26	660–1800	1 or 2	40	Rot.-Cab.
Conroe	3	3	2	7	3000–7400	3 or 4	40	Rotary
Refugio County	11	10	6	20	5200	2	38	Rotary
Oklahoma								
Oklahoma City	5	5	6	25	6500	3	39	Rotary
Osage County	25	17	14	58	380–2850	2	37.5–40	Rot.-Cab.
Kansas								
Harvey County	3	3	4	7	3450	2 or 4	37	Rot.-Cab.
McPherson County	6	3	6	21	2900–4300	2	38	Rot.-Cab.
Ellsworth Arch	35	26	19	76	3300	4	37	Cable
California								
Kettleman Hills	2	2	2	25	8300	3 or 4	40	Rotary
Long Beach	7	7	5	17	7000	3	26	Rotary

Field Activities by States for October, 1934

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1933 (In Barrels)
	October	September	October	September	October	September	October	September	October	September	
Arkansas	7	9	3	4	8	10	6	6	37	35	11,682,100
California	42	45	38	40	30	50	52	55	198	207	173,126,800
Colorado	6	....	0	....	....	....	6	5	34	32	954,900
Illinois	....	....	....	....	....	....	3	2	12	13	4,250,000
Indiana	....	20	....	15	....	....	2	1	42	45	730,000
Kansas	76	61	52	37	81	80	33	32	161	157	41,927,700
Kentucky	57	27	41	24	....	....	3	2	41	39	4,610,000
Louisiana	67	64	44	35	66	47	55	57	180	178	24,487,800
Michigan	31	33	21	22	25	37	104	106	127	131	7,790,800
Mississippi	5	4	0	0	....	....	4	5	13	12	Gas. Prod.
Montana	14	34	12	27	....	....	15	17	78	75	2,128,700
New Mexico	9	14	9	14	....	....	9	10	76	74	13,086,600
New York	....	....	....	....	....	....	1	0	10	8	3,150,000
Ohio	113	85	87	69	....	....	44	49	208	201	4,300,000
Oklahoma	148	110	97	67	167	115	85	81	451	436	181,133,200
Pennsylvania	30	9	26	9	....	....	15	17	43	41	12,690,000
Texas	756	693	575	509	667	735	277	297	1063	1133	396,993,600
West Virginia	56	29	46	28	....	....	34	37	79	76	3,825,000
Wyoming	3	4	1	3	....	....	8	9	67	64	11,211,000
Total	1420	1241	1052	903	1083	1074	756	788	2920	2957	898,078,200

PROGRESS OF MAJOR PIPE LINE WORK

WORK has started on the 108-mile, 12-in. pipe line the Standard Oil Company of California is laying from its Rio Bravo pump station in Kern County to tidewater at Estero Bay. The project is expected to be completed and oil going through the line by early spring of 1935.

Seventeen miles of new seamless pipe will be used in the construction of the line, with the remaining 91 miles consisting of pipe salvaged from unused portions of the company's existing system. The latter will be reconditioned at the Standard's salvage plant in the Kettleman Hills and welded into 40-ft. lengths. The entire line will be electrically welded.

That portion of the line laid in soil of a corrosive nature will be coated, and present plans call for 27 miles to be so treated.

In addition to constructing 108 miles of line, the project will include the erection of five new pump stations and the remodeling of the existing stations at Rio Bravo and Kern River. New tankage amounting to 1,800,000 bbl. in capacity is to be added, 900,000 bbl. at the Estero pump station and 900,000 bbl. at the Rio Bravo station.

●

Construction is actively under way on the Lone Star Gas Company's new transmission line from the Long Lake field of Anderson County, Texas, to Riesel, near Waco, where it will tie into the company's Central Texas trunk line system. Existing plans call for completion of the line by December 1, and present indications are that the work will be finished on schedule. Two crews are being employed, working from each end of the line in order to speed up production.

As announced previously in *The Petroleum Engineer*, this is a 75-mile, 12-in. line, the pipe for which has been salvaged from abandoned portions of the Lone Star's system. Before being shipped the pipe was put through cleaning machines, and is being given a second workover before being insulated and wrapped.

The line will run through McLennan, Falls, Limestone, and Freestone counties, across the Trinity River, and into the southwest of Anderson County. The A. F. Day Construction Company, Dallas, Texas, is the general contractor.

●

The oil line of the Standard Pipe Line Company, extending from Mandeville, Arkansas, to the Standard's refinery at Baton Rouge, Louisiana, is being reconditioned. A crew is at work welding pitted portions of the line and repainting the pipe. The line, which is really several lines laid along the same right-of-way, will be reconditioned north to the Louisiana-Arkansas line. The capacity of the line is 90,000 to 100,000 bbl. per day.

●

The Gulf Refining Company has completed its 20-mile, 6-in. oil line from the Vinton field in Calcasieu Parish, Louisiana, to the East Hackberry field in Cameron Parish. The line connects with the company's main system in the Vinton field, and is the first pipe line outlet for the East Hackberry field. Previously the oil was transported in barges.

●

A 16-mile, 20-in. gas line will be constructed in the near future by the Warfield Natural Gas Company of Prestonburg, Kentucky, it is reported. According to the report, the line will extend from Cleark Creek to Knott County, to connect with the company's new gas developments in that county.

●

Two compressor stations are under construction by the Kentucky Natural Gas Corporation, with general offices at Owensboro, Kentucky. Each station will be equipped with two 180-hp. compressor units. The stations are being constructed to care for the additional load developed on the company's 630-mile transmission system that extends from the gas fields in Medcalf, Barren, Green and Hart counties, Kentucky, to Terre Haute, Indiana, with numerous laterals to consuming centers and other gas fields near the trunk line.

●

Porterville, California, and several other cities in the surrounding territory may be supplied with natural gas by a municipally owned distribution system and a proposed pipe line in Tulare County. The line would originate in the Kettleman Hills gas field and Porterville would be its east-side terminus. City councils in the towns that would be served are considering the advisability of constructing the line. Surveys are being made of consumer demand and of the possibilities for distributing the gas for operating city power plants. The Southern California Gas Company of Los Angeles serves Porterville and many of the surrounding towns.

●

With the southern branch of the Iraq Petroleum Company's 1200-mile pipe line completed, the port of Haifa, Palestine, received its first crude from the Iraq field on October 15. The oil was stored at Haifa until the end of the month at which time shipments abroad commenced. The northern branch of the Iraq line was completed last summer, the first oil being received at the Tripoli terminal late in August.

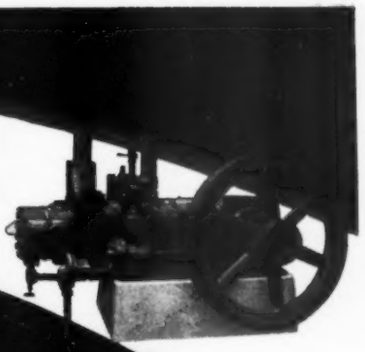
●

Construction work is in progress on the Southern Ontario Gas Company's 12-mile pipe line, which will take production from F. H. Stover & Sons' No. 1 in the Dover field, Kent County, Ontario.

●

Construction of the Lowville, N. Y., Gas Corporation's 4-in. pipe line from the Tug Hill gas wells to connect with the company's trunk system is nearing completion. It is expected that natural gas will be available to residents of Lowville this month.

This PUMPING ENGINE



SOME producing companies find it an advantage to install their Cooper-Bessemer pumping engines with compressor-type main frames. Compressor cylinders may be added later, if the pneumatic method is desired for some of the wells.

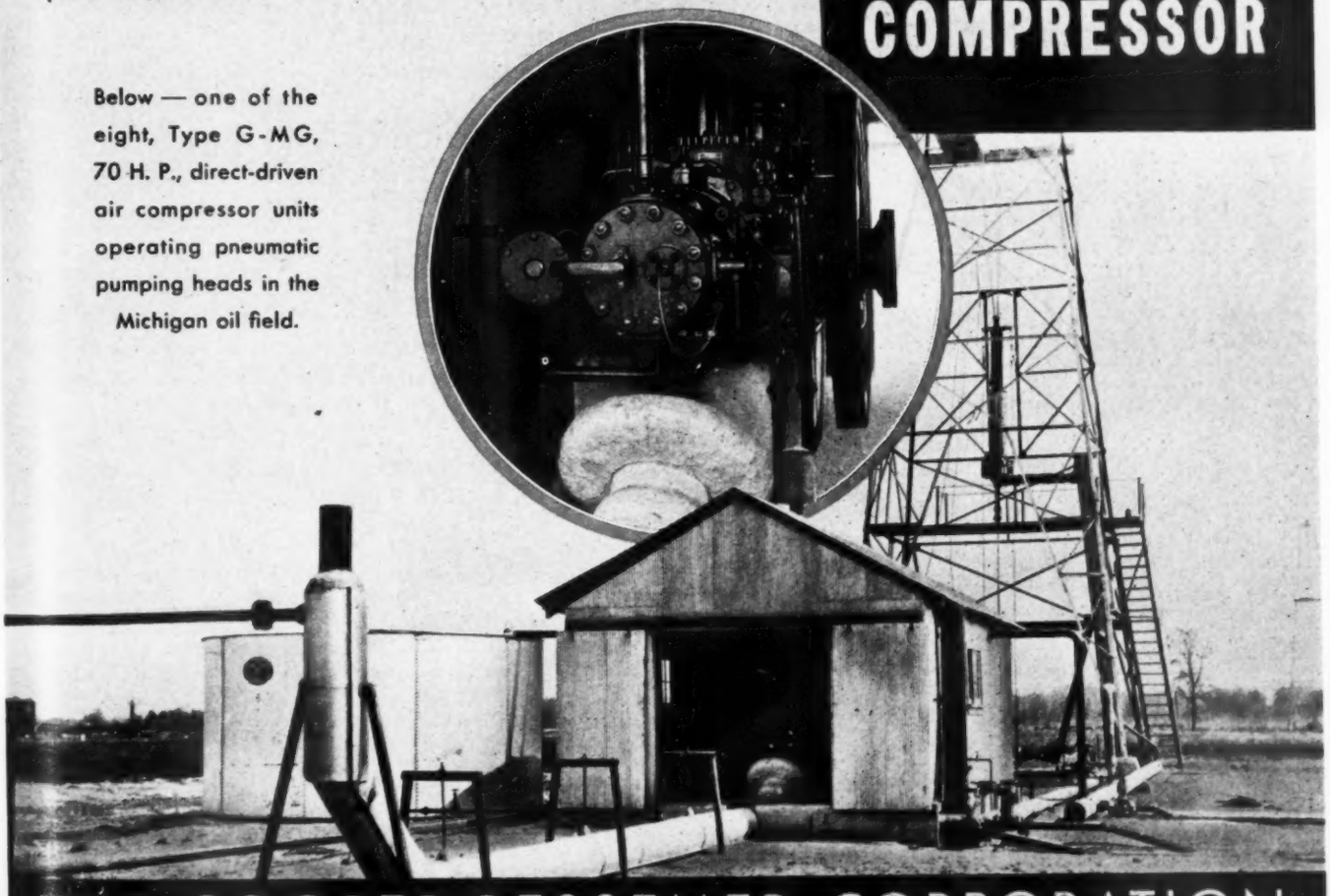
Duplication of spare parts is avoided, because the power end of the Type G-AG pumping engine is the same as the power end of the Type G-MG compressor unit.

Two sizes of engines can be furnished with compressor frames—Type G-AG rated 30 to 50 H. P.—Type G-AO, rated 40 to 70 H. P. Type G-AO is convertible to a cold starting full Diesel.

Refineries and gasoline plants, will find these up to-date two-cycles dependable and economical for driving generators, compressors, water pumps, oil pumps, or line shafts.

The Cooper-Bessemer representative can give you complete information.

ALSO MAKES A GOOD COMPRESSOR



Below — one of the eight, Type G-MG, 70 H. P., direct-driven air compressor units operating pneumatic pumping heads in the Michigan oil field.

THE COOPER-BESSEMER CORPORATION

Mt. Vernon, Ohio — PLANTS — Grove City, Pennsylvania

640 East 61st Street, Los Angeles, Calif. | 201 East 1st Street, Tulsa, Okla. | 1314 Magnolia Bldg., Dallas, Texas | 25 West 43rd Street, New York City | 225 Crockett Street, Shreveport, La. | 505 Esperson Bldg., Houston, Texas

THE MONTH'S ACTIVITIES IN REFINING

Per Cent Refining Capacity Operated

Eastern Division, 79.6 Per Cent **Central Division, 66.1 Per Cent** **Western Division, 56.7 Per Cent**

CONSTRUCTION of a refinery in the Waltershof section of the Hamburg, Germany, harbor, started in January of this year by the Europaische Tanklager und Transport A.G., is well under way. Twelve tanks, each eight meters high and having a diameter of 30 meters, with capacity sufficient to store a tanker's cargo, already have been completed and other work is progressing rapidly. The company recently purchased additional land in the same section to provide for an extension of the plant.

●

Plans have been made for the construction of a refinery on the Lincolnshire side of the Humber River opposite Hull, England. The site covers 53 acres and has a frontage of 2000 ft. on the river, with deep-water loading and unloading facilities. It is estimated the project will cost $1,330,000.

The refinery is expected to be completed in May or June of 1935, and a high grade lubricating oil will be manufactured. According to estimates the plant will be capable of producing annually 45,000 tons of lubricating oils and by-products.

Completion of this refinery will make the Humber area one of the most important oil refining centers of the United Kingdom.

●

The Home Oil Refining Company has let a contract to the Ralph M. Parsons Company of Mount Vernon, Ohio, to remodel its refinery at Great Falls, Montana. The construction will include the latest type cracking unit designed by Parsons to operate the Dubbs cracking process. The unit will be of the two-coil selective cracking type, of 1000-bbl. capacity, and will be equipped with a stabilizer, an absorber, and a special treating system. Additional boilers and equipment for vacuum distillation of asphalt also will be installed.

The refinery at present has a 1200-bbl. pipe still, equipped with a Braun fractionating column and two 80-hp. boilers. The plant is operating on Pondera and Oregon Basin crudes, producing gasoline, kerosene, gas oil, fuel oil, and road oil.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending October 20, 1934

A. P. I. Figures

(Figures in Barrels of 42 Gallons Each)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	499,000	85.7	13,002	14,647
Appalachian	93.3	96,000	68.6	1,618	1,731
Ind. Ill. Ky.	94.6	356,000	84.4	6,615	5,387
Okla. Kans. Mo.	83.7	229,000	59.3	3,811	3,806
Inland Texas	47.6	93,000	55.7	903	1,465
Texas Gulf	97.5	440,000	79.7	3,909	10,201
La. Gulf	96.4	115,000	71.0	1,379	3,306
No. La.-Ark.	83.7	50,000	64.9	289	573
Rocky Mt.	66.7	41,000	64.1	462	531
California	96.9	406,000	49.4	10,965	73,521
TOTALS WEEK:					
Oct. 20, 1934	89.7	2,325,000	68.9	42,953	115,168
Oct. 13, 1934	89.7	2,267,000	67.2	43,109	115,317

The Phoenix Refining Company, headed by Raymond R. Russell of San Antonio, operating several refineries in the State of Texas, including one at Dallas, has purchased the West Dallas refinery of the former Oriental Oil Company, Inc. The Oriental plant, closed since May, will be reopened as soon as the gasoline market structure becomes stabilized, E. E. Wallace, manager, has announced. The Phoenix Refining Company's 800-bbl. plant on the Eagle Ford Road, Dallas, is being dismantled and moved to Abilene, Texas, to operate there. The Oriental refinery is a 4000-bbl. cracking plant and is reported to have cost $200,000 to construct. The sale price is understood to have been $25,000.

●

Canadian Oil Companies, Ltd., Canadian subsidiary of the National Refining Company of Cleveland, Ohio, during the next six or seven months will spend $350,000 to $400,000 in improving its refinery at Petrolia, Ontario. The additions will consist of a topping and cracking unit, a vapor recovery plant, a water-cooling tower, pump houses and a continuous-treating plant. Twelve additional storage tanks of 2000- to 5000-bbl. capacity each also will be constructed.

●

The Cushing Refining & Gasoline Company has taken a Dubbs license, the agreement being signed by R. H. Winget, vice-president and general manager of the company. Several months ago construction of a cracking unit was begun in the company's Cushing, Oklahoma, refinery, according to the design and under the supervision of the company's own engineers. It is this unit that is nearing completion and is to be operated under Dubbs license.

Immediately following signing of the license agreement, five Universal engineers left for Cushing to complete the unit to operate in line with the most modern Dubbs practice. It is expected that the unit will shortly be in operation.

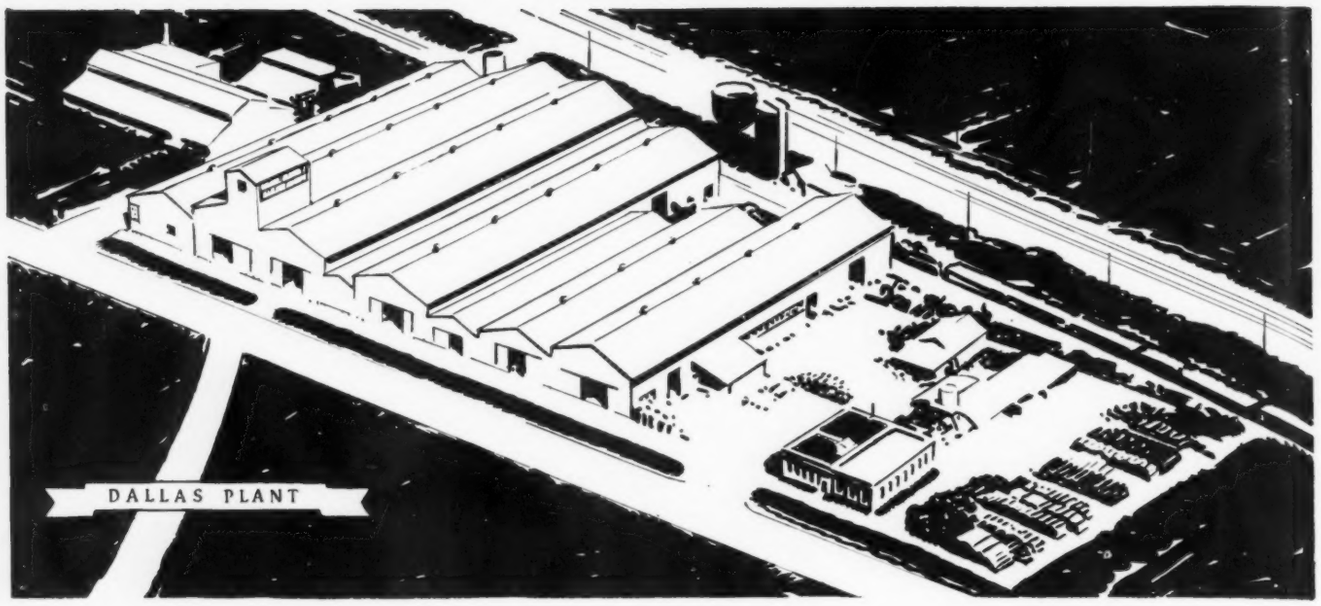
Dallas

CENTER OF THE MID-CONTINENT OIL AREA

Extends WELCOME

. . . TO THE AMERICAN PETROLEUM INSTITUTE

NOVEMBER, 12-15, 1934



Twice Welcome to Texas

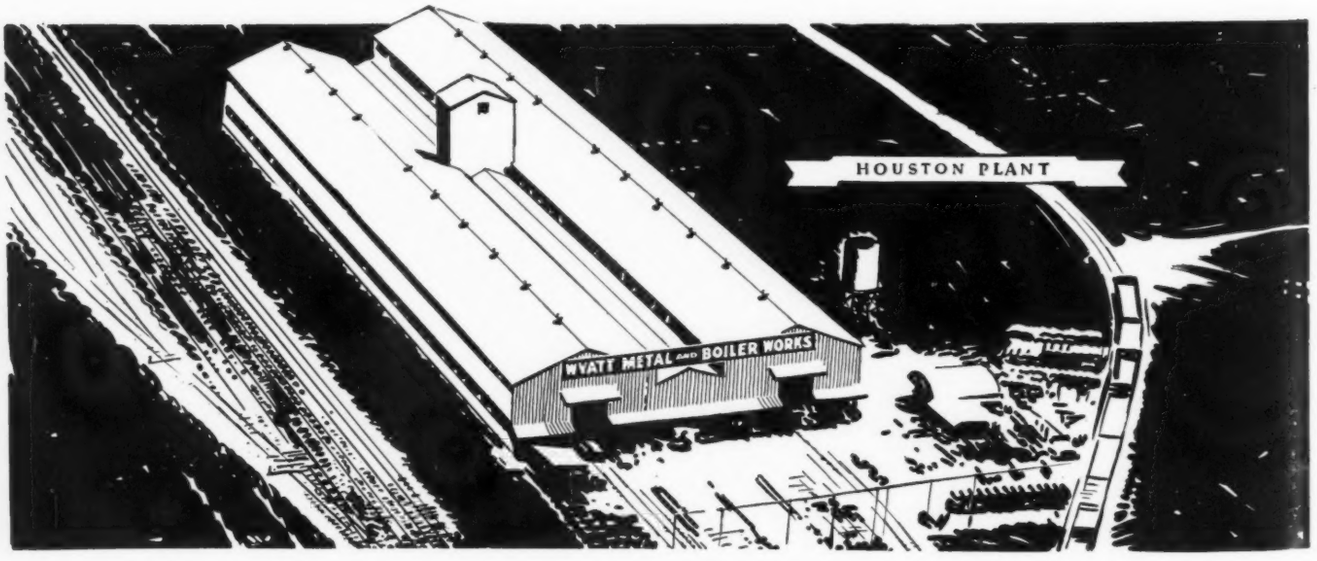
• The Wyatt Metal & Boiler Works, with plants in Dallas and Houston, extends a double welcome to the Members of the American Petroleum Institute meeting in Dallas in November.

• For welded tanks, heavy refinery work, welded pipe and underground storage tanks, Wyatt's two plants offer quick shipment with full advantage of freight rates on incoming and outgoing tonnage.

WYATT METAL AND BOILER WORKS

Capital $1,000,000

DALLAS HOUSTON



EDWARD T. MOORE
President, Texas Division Mid-Continent Oil and Gas Association

CHARLES E. TURNER
Mayor of the City of Dallas

R. L. THORNTON
President Dallas Chamber of Commerce

Welcome to Dallas

Mid-Continent Oil & Gas Association
TEXAS DIVISION
P.O. Drawer 1417
DALLAS, TEXAS
Oct. 19, 1934

To Directors and Members of the American Petroleum Institute,
The Oil Fraternity generally; also,
The Allied Interests:

The Texas Division of the Mid-Continent Oil & Gas Association is happy to join the citizens of Dallas in extending to you a cordial welcome to Dallas on the occasion of the Fifteenth Annual Meeting of the American Petroleum Institute.

Local Committees of the fraternity have made extensive preparations for your pleasure and comfort while attending this meeting.

It is believed the holding of this annual meeting in this centrally located city will afford an opportunity for a large attendance of the fraternity, and bring about a better understanding of the problems of the oil man.

Cordially yours,

Edward Moore
President.

R. L. THORNTON
PRESIDENT

DALLAS CHAMBER OF COMMERCE

The business men of Dallas count it a privilege and an honor to have as the guests of the City, the State of Texas, and the Southwest, the members of the American Petroleum Institute for their fifteenth annual convention. We sincerely hope that your attendance upon the meeting will be a most pleasant one and that the session will prove of real value to those who engage in the consideration and discussion of the many problems confronting the petroleum industry today.

Dallas and the Southwest appreciate their debt to petroleum. For over a quarter century the people of this territory have received rich bounties, and as time passes they realize more and more what the industry has meant in the development of their respective communities and their own personal advancement. Now comes the opportunity for showing our appreciation, and with sincere optimism we join with the A.P.I. in seeking a better understanding of the industry's problems.

I hope your visit will be enjoyable and invite you to return in 1936 when we will celebrate The Texas Centennial.

DALLAS CHAMBER OF COMMERCE
R. L. Thornton
President

CITY OF DALLAS
TEXAS
CHAS. E. TURNER
MAYOR

October 22, 1934

To the Officers and Members of the
American Petroleum Institute

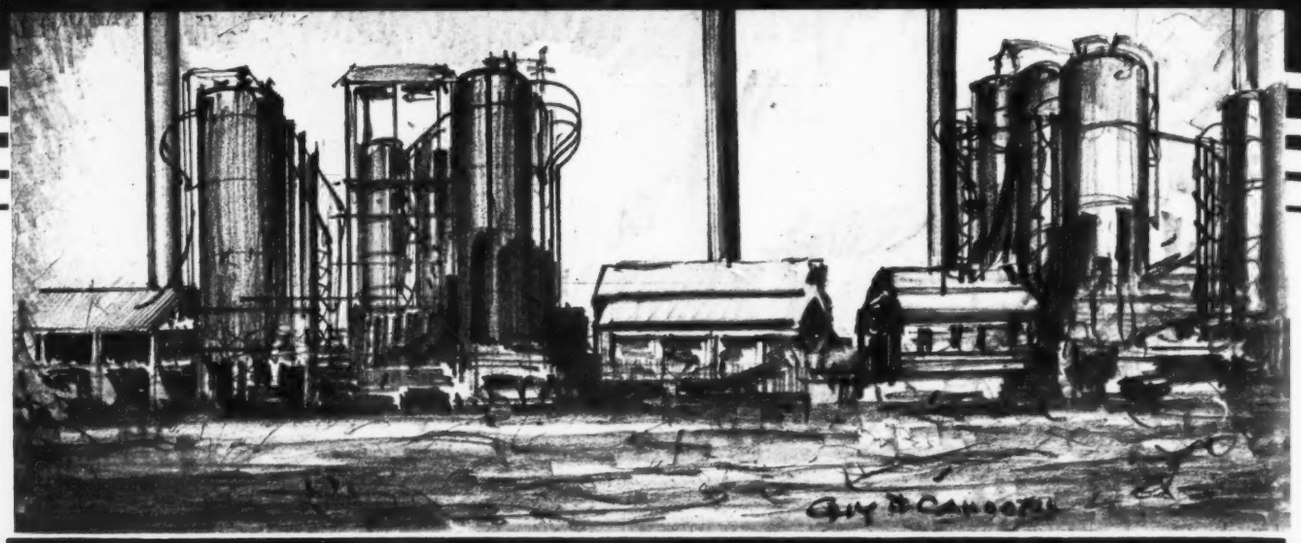
Gentlemen:

The City of Dallas counts it a very distinct privilege and a real pleasure to have you as its guests during the approaching meeting of the American Petroleum Institute which will be held in this city November 12 - 15, inclusive.

As Mayor of Dallas, speaking for myself, for the other city officials, and for every citizen in Dallas, I extend to each of you a most hearty welcome and wish for you a most happy and a most successful convention.

For more than a third of a century we have known petroleum in this area and now we want to know you and to be of any assistance we can in making your stay one you will remember with pleasure. Dallas is at your service and we await any opportunity of cooperating with you to the end that your meeting may be an entire success.

Cordially yours,
Chas. E. Turner
Mayor



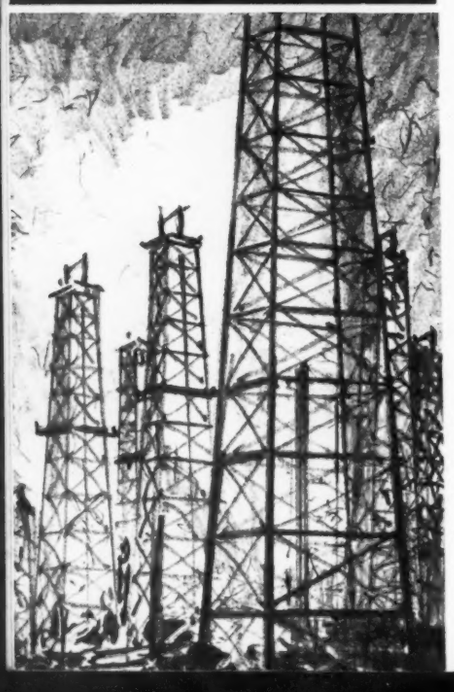
DALLAS

Geographical Center of the Mid-Continent Oil Industry

THE selection of Dallas as the city in which to hold the fifteenth annual meeting of the American Petroleum Institute is a tribute to Texas as a leading oil producing state of the Union, and to Dallas as the geographical center of the petroleum industry in the Mid-Continent area.

Since 1895, when Texas' first commercial oil production was discovered at Corsicana, thus giving Dallas its introduction to petroleum as an industry, the city has enjoyed a steady growth as an oil center.

Prior to the Corsicana discovery some small quantities of petroleum had been found in the state, but the actual beginning of the industry in Texas is considered as dating from that time. Even before Colonel Edwin L. Drake drilled in the country's first well at Titusville, Pennsylvania, in 1859, petroleum was benefiting a portion of the inhabitants of Texas. Not as a fuel, but as medicine.



Many years later a few shallow producing wells were found near Nacogdoches. These soon played out, however, and the Texas oil industry is historically recorded as having its beginning in 1895, when the first well was brought in at Corsicana.

The discovery of oil there was quite by accident. Drilling in search of water, the American Well and Prospecting Company encountered a showing of oil and encouraged a group of men to drill for it. Their efforts were rewarded by a producer, brought in October 15, 1895. Compared with the wells of today this first well was small indeed. It produced but 2½ bbl. a day. Drillers of the second well were more fortunate, obtaining a producer making 22 bbl. a day from a total depth of 1040 feet. The drilling of other wells followed rapidly, all producing from a depth of approximately 1000 ft., and by 1896 the Corsicana field was yielding 1450 bbl., and by 1897 the total production had reached 65,000 bbl. a year, representing the entire output of the Southwest at that time.

This rapid increase in oil production was responsible for a new problem. The output being greater than the market for crude, another branch of the oil industry was born of necessity in the state—that of refining.

J. S. Cullinan, a successful operator in the Pennsylvania field, was prevailed upon by the mayor of Corsicana and his associates, to look over the new field with view to constructing a refinery. Arriving in 1897, Cullinan was favorably impressed with the possibilities of the field and determined to carry out the project. With Calvin N. Payne and Henry C. Folger, he organized the J. S. Cullinan Company, and the refinery was completed in 1898. The J. S. Cullinan Company later became the Magnolia Petroleum Company, one of the first major oil companies to make Dallas its headquarters. E. R. Brown, for many years president of the Magnolia, was brought to Corsicana to supervise construction of the Cullinan refinery and later was placed in charge of its operation as superintendent.

Oil had been found in small quantities in other states now designated as the Mid-Continent area prior to the bringing in of the Corsicana field, but following the latter's discovery the search for oil became feverish and the drill active. New fields were brought in almost yearly. In Texas, the old Powell field was opened in 1900, Spindletop at Beaumont in 1901, Sour Lake in 1902, Batson in 1903, Petrolia in 1904, Humble, Saratoga and Matagorda in 1905, Electra in 1911, Ranger in 1917, Burkburnett in 1918, Mexia in 1920, Borger in 1921, Luling in 1923, Van in 1929, and East Texas in 1930, to mention but a partial list of the fields developed since the first discovery at Corsicana. Other states in the Mid-Continent also were active. Oil was found at Chelsea, Oklahoma, in Rogers County, as early as 1890. Production in that state began to take on important commercial aspects, however, about the same time as in Texas. At Dewey and Bartlesville oil was found in 1897. In 1901 Tulsa entered the petroleum picture. Glen pool was opened in 1905 to flood the crude market; oil had been found at Muskogee the year before, and numerous fields were brought in from that time on, including Seminole in 1926, and Oklahoma City field in 1928. The Smackover field in

A *SAFER* TUBING SPIDER

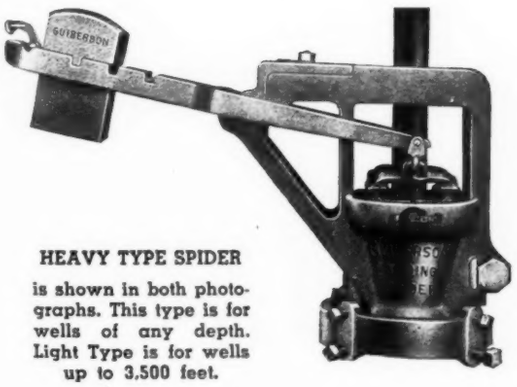
The *safety* of the GUIBERSON Tubing Spider is suggested by this photograph.

The tubing is guided to center of spider's bore by the new adjustable guide head, and slips are accurately operated by the lever, on which the weight can be set so that it automatically raises the slips or so that slips ride tubing.

Operator thus does not need to place his hands near the slips, but operates them quickly and accurately with the lever handle. He stands back from the well, keeping out of the way of the elevator, and does not inhale gas fumes, nor are his eyes subjected to poisonous gases.

It being unnecessary for him to watch the slips—he can at all times watch the operation of the tubing.

This new spider has many exclusive advantages. Allow us to send descriptive folder. Fully Patented.



HEAVY TYPE SPIDER

is shown in both photographs. This type is for wells of any depth. Light Type is for wells up to 3,500 feet.

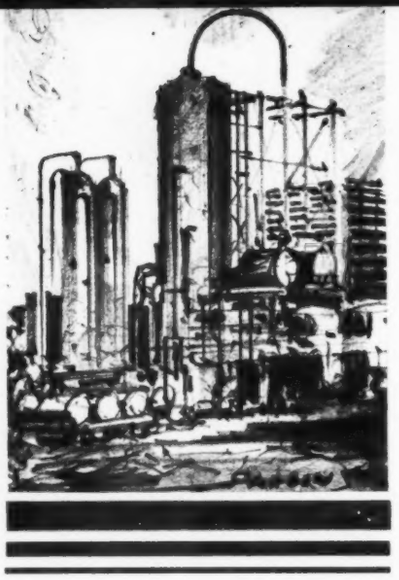
THE GUIBERSON CORPORATION

Box 1106, Dallas, Texas

LOS ANGELES: 1304 Security Title Insurance Building—TULSA: 504 Wright Building—HOUSTON: 635 Norfolk St.—PONCA CITY, OKLA.: 321 South Osage St.—NEWARK, OHIO: First & Locust Sts.

GUIBERSON

BETTER BE SAFE THAN SORRY



Arkansas came in in 1922, and during the height of that boom it had the distinction of being the largest oil field in the world. Louisiana became one of the oil producing states in 1905, Caddo Parish in the northwest part of the state, being the scene of the first petroleum activity.

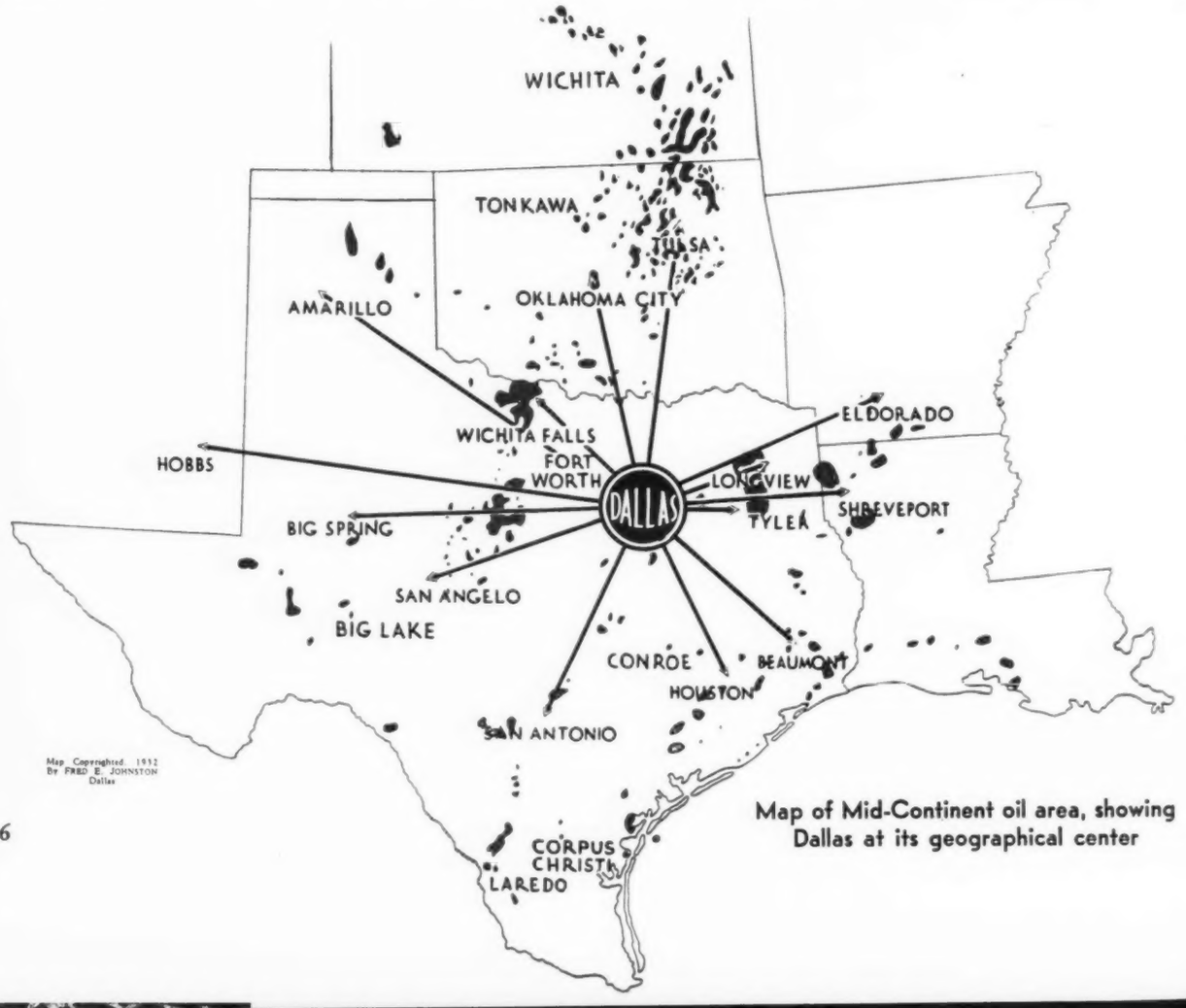
It is interesting to consider how these and many other fields have sprung up one by one in the Mid-Continent area with Dallas as an almost exact geographical center. An idea of this fact may be gained from the accompanying map and from the following information showing the highway mileage from Dallas to some of the leading oil centers:

To Amarillo, 385 miles; Beaumont, 335 miles; Big Spring, 311 miles; Conroe, 205 miles; El Dorado, Ark., 290 miles; Houston, 250 miles; Longview, 136 miles; Oklahoma City, 222 miles; San Angelo, 280 miles; San Antonio, 291 miles; Shreveport, 202 miles; Tulsa, 318 miles; Tyler, 102 miles; Wichita Falls, 157 miles.

The growth of Dallas as an oil center has been particularly rapid the last four years—since the discovery of the East Texas field. The facts concerning that field, which was four years old October 3, are well known to all. When C. M. (Dad) Joiner's No. 3 Daisy Bradford, a wildcat in Rusk County, was discovered no one in the industry could forsee that it was the beginning of the world's largest oil field, one that was destined to embrace an area of approximately 120,000 acres, measuring nearly 50 miles in length and three to eight miles in width. At the time no one had the faintest conception that the field eventually was to have a total of more producing wells than any yet in existence (at present numbering nearly 15,000, with 80 to 100 new wells being brought in each week). Already East Texas has produced more than a half-billion barrels of oil and it is estimated that the field ultimately will give up from 2,000,000,000 to 3,000,000,0000 barrels. Should these estimates prove accurate, it will be the first time the country has ever had such a prolific field.

The discovery of East Texas has meant much to Dallas. Situated but slightly more than 100 miles from this field, together with the fact that it is centrally located to all the other major pools of the Mid-Continent, has made the city logical headquarters for oil companies large and small, as well as for supply houses, drilling contractors, engineers, geologists, and others connected with the petroleum industry. A recent tabulation reveals that currently there are located in Dallas 241 oil companies, four refineries, 238 independent operators, 56 royalty companies, 33 drilling contractors, 16 pipe line companies, nine natural gas producers and marketers, five natural gasoline manufacturers, 15 consulting geologists and geophysicists, seven engineering organizations, three oil and gas associations, six pipe line contractors, 186 supply companies handling equipment and materials for producers, refiners and marketers, one map company and one publication.

Among these companies are included some of the leading producing, manufacturing and supply organizations of the world. The Magnolia Petroleum Company moved its general offices to Dallas from Corsicana in 1914. At that time John Sealy, now deceased, was president of the organization, and D. R. Brown, vice-president and general manager. Mr. Brown, until a year ago, headed the Magnolia. He is now chairman of the Board and D. A. Little is president. The Sun



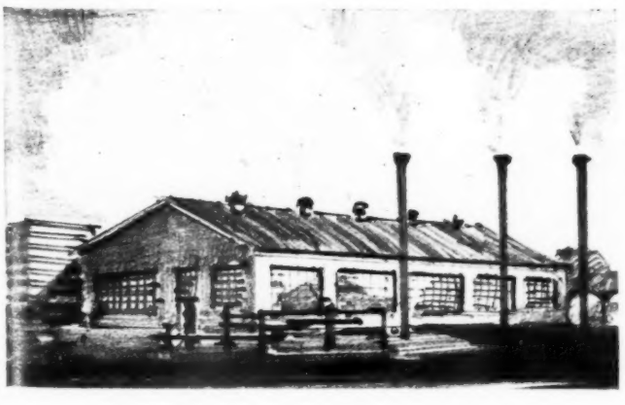
Map of Mid-Continent oil area, showing Dallas at its geographical center

Oil Company established its general offices here in 1918. J. Howard Pew, who is president of the company now, also was in charge at that time. Another producing organization, the Atlantic Oil Producing Company, set up its Southwestern administrative offices in Dallas the same year. J. W. Van Dyke, president of the company, also was its head at that time. The Simms Oil Company came to Dallas in 1921, Edward T. Moore, then as now, being the president. In 1924, Captain J. F. Lucey organized the Lucey Petroleum Company in Dallas, where headquarters have since remained. The American Liberty Oil Company originally was organized in Dallas as the Golding-Murchison Oil Company. This was in 1931 with Dudley S. Golding as president, a position he continues to occupy. The East Texas Refining Company was formed that same year with Freeman Burford at its head. The California Company, whose general headquarters are in San Francisco, established its Southern district headquarters in Dallas in July, 1929. R. H. Morrison has been manager of the office since 1930.

Comparatively recently two of the leading supply companies moved their headquarters to Dallas—The Continental Supply Company and the Oil Well Supply Company. These, together with the organizations already here, have made Dallas one of the most important supply centers in the industry. The Oil Well Supply moved its headquarters from Pennsylvania, to Dallas in 1932, and the Continental Supply Company from St. Louis, Missouri, on October 16, 1933.

Among the leading oil field equipment manufacturers in Dallas is the Guiberson Corporation, manufacturers of oil drilling and producing equipment. This concern was organized in 1919 and has had but one president since its inception, S. A. Guiberson, Jr. The Wyatt Metal and Boiler Works, manufacturers of tanks and refinery equipment, was founded in Dallas in 1913. W. J. Wyatt has served as president since the beginning of the organization. Dudley S. Golding heads the American Lubricator Company, formed in 1934 to manufacture and distribute the Standard force and sight feed lubricator, made for the lubrication of all motors and engines and also for the chemical treating of oil en route from the well to pipe line delivery points. The Southern States Company, manufacturers of producing and drilling equipment, transferred its headquarters from Shreveport this year. Organized in June, 1928, the company has been owned from the beginning by H. C. Otis. The Mosher Steel and Machinery Company, fabricators of structural steel, was founded here in 1885 by Theodore Mosher, father of W. S. Mosher, who has been president of the company for the last 30 years. The Welded Tank and Steel Company was organized in 1933 to manufacture tanks, steel houses and steel derricks. Dee E. Humphrey is president of this concern.

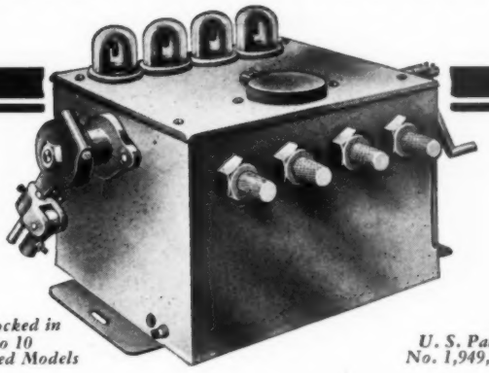
One of the leading producers, transporters and distributors of natural gas, the Lone Star Gas Company, was founded in 1909 and established headquarters in Dallas in 1919. L. B. Denning, Sr., has served as president of the company since its organization.



NOW

...a Lubricator that Lubricates Against

3,000 Pound Pressure!



Stocked in 1 to 10 Feed Models

U. S. Patent No. 1,949,272

...and Does it Continuously

Under Oil Field Conditions

"Standard" delivers the goods—guarantees to lubricate at pressures up to 3,000 pounds in heaviest duty drilling and compressor work—because each pumping unit is built to do just that and to keep on doing it. And when replacement of any part does finally become necessary the standardized and interchangeable parts, new or old, fit quickly and easily into place without stopping the other pumping units in a reservoir. Each pumping unit adjusts at the touch of a finger to pump the precise amount of lubricant required and is removable without using tools for inspection, cleaning, etc., while in operation.

Standardize with "Standard" Lubricators

STANDARD
FORCE and SIGHT FEED
LUBRICATORS

Equipped with roller-bearing clutch instead of Ratchet Wheel, Pawl and Pawl Springs—and with Bronze Oilless Bearings instead of Stuffing Boxes—and with die-cast Pumping Unit; stainless steel plungers; hardened, precision-fit stainless steel valves (no balls)—"Standard" lubricators offer positive lubrication at lowest cost over a virtually endless service life.

Sold by Leading Oil Field Supply Houses

AMERICAN LUBRICATOR COMPANY,
First National Bank Bldg., Dallas, Texas.

Gentlemen: Send complete facts about Standard Force and Sight Feed Lubricators to

Name .....

Address .....

.....

Modern PUMPING

THE MOST COMPLETE FIELD-PROVED LINE

•

SINGLE CRANK UNITS

NO. 5

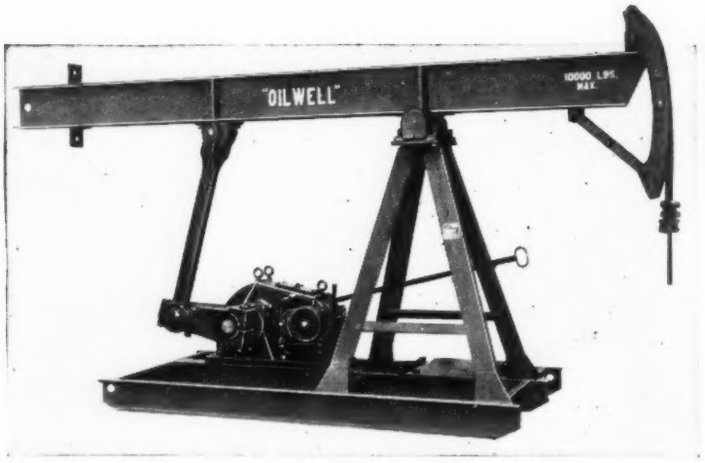
5,000 lbs. Polished Rod Load Capacity
Stroke Range 12″ to 24″

NO. 10

10,000 lbs. Polished Rod Load Capacity
Stroke Range 22½″ to 37½″

ODH-18

14,000 lbs. Polished Rod Load Capacity
Stroke Range 22½″ to 52½″



Illustrating "OILWELL" *No. 10* SINGLE CRANK UNIT POWER—*a sturdy and economical unit for Light Wells.*

TWIN-CRANK UNITS

TC-20

14,000 lbs. Polished Rod Load Capacity
Stroke Range 22½″ to 52½″

TC-27L

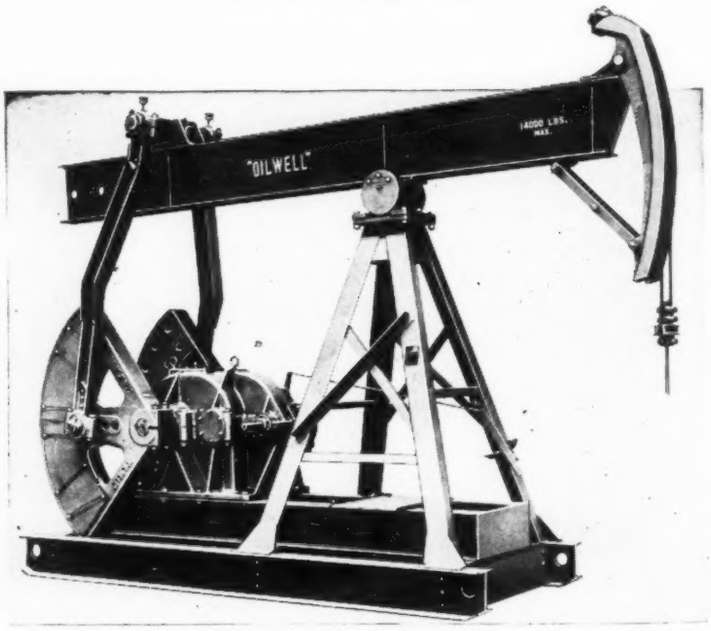
20,000 lbs. Polished Rod Load Capacity
Stroke Range 24″ to 54″

TC-27H

25,000 lbs. Polished Rod Load Capacity
Stroke Range 24″ to 74″

TC-35

25,000 lbs. Polished Rod Load Capacity
Stroke Range 24″ to 74″
(Has same structural rig as TC-27H Unit with larger H.P. capacity Reduction Gear.)



Illustrating "OILWELL" *TC-20* TWIN-CRANK UNIT POWER *having twin counterbalanced cranks. Positive equalized load on both cranks and pitmans gives smooth, efficient, trouble-free performance in field.*

"OILWELL"

UNITS by "Oilwell"

. . . A UNIT FOR EVERY PUMPING SERVICE

"OILWELL" DESIGN FEATURES:

- Rugged, Arc-Welded Rig.
- Compact and Portable.
- Minimum Installation Cost.
- Arc or Link Type Hangers.
- Wide Stroke Range.
- Self-Locking Service Brake.
- Adjustable Counterbalances.
- Two-Well Pumping Attachment.
- Enclosed Weather-Proof Oilbath and Grease-Packed Bearings.
- Double Reduction Speed Reducers, with Helical Heat-Treated Gears.
- Conservative Oil Country Rating.
- Wide Selection of Prime Movers.
- Ample Clearance for Well Servicing.

Ask our nearest store for detailed information.

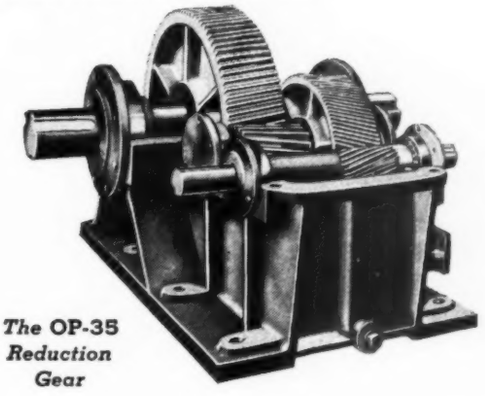
Visit "OILWELL'S"
72 Years of Progress
Machinery Exhibit
at "OILWELL's" Headquarters
2001 North Lamar Street
When Visiting Dallas

A. P. I. MEETING

NOV. 12-15 INC.

"OILWELL" REDUCTION GEARS
WESTINGHOUSE-NUTTALL
FOR ALL PUMPING CONDITIONS

Silent Helical Gears, Precision Cut, Heat-Treated; Anti-Friction Bearings; Oilbath Lubrication; Quick-Acting Brake; Extra Heavy Oiltight, Weatherproof Case. • • *For Single and Twin-Crank Pumping Units:* ODH-110, ODH-18, TC-20, OP-27, OP-35. • • *For Rig Front and Back Crank Installations:* OP-20, OP-27, OP-35, OP-45.



The OP-35 *Reduction Gear*

OIL WELL SUPPLY CO.
Subsidiary of United States Steel Corporation

Branch Stores in all Oil Fields

2807

"OILWELL"

Welcome . .

A. P. I. Visitors

to the Headquarters City of East Texas Refining Co.

Participating in the general welcome being extended the American Petroleum Institute by Dallas and the entire State of Texas, we add our felicitations and invite our friends from over the oil world to look us up while here. . . . . .

•

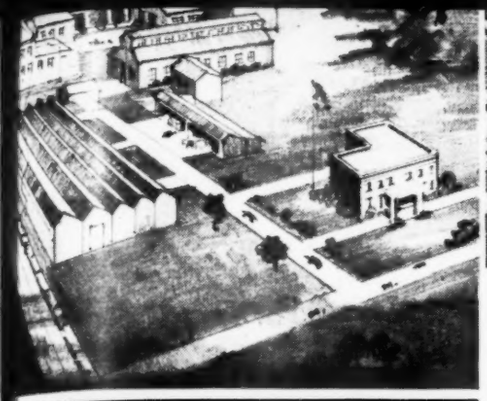
Marketers of

Silencer and Silencer Ethyl Gasolines

Dixie Stations all over East Texas

East Texas Refining Co.

Tower Petroleum Building
DALLAS, TEXAS



Left: Plant and offices of The Guiberson Corporation, Dallas. Above: Dallas plant of Wyatt Metal and Boiler Works. Right: Dallas headquarters of Oil Well Supply Company

DALLAS

As a Distributing Center

CONTRIBUTING in large measure to the growth of Dallas has been the importance it early assumed as a distributing center. By virtue of its strategic location for close contact, quick service, and low-cost distribution, Dallas yearly has grown in importance as a distributor of commodities to the entire Southwest, and while thirty-third among the nation's cities in point of population, it ranks thirteenth as a wholesale market. Its annual sales volume approximates one billion dollars. Wholesale and manufacturing interests employ 10 per cent of the population of Dallas, or 25 per cent of the employable people; and numerous other industries in the city are built upon this foundation of distribution.

The Southwest region, of which Dallas is the recognized distributing center, consists of Texas, Oklahoma, Arkansas and Louisiana. It is one of the country's major markets, and because of its vast area and its distance from primary manufacturing centers it must be served by facilities from within its borders. For this reason there have been located in Dallas distributing branches, sales offices and other facilities designed to supply this service.

Among the products manufactured and distributed from Dallas are the following: Dry goods and notions; hardware, implements and machinery; oil well equipment; oil; furniture, rugs and carpets; harness, saddlery and leather goods; foods; printing equipment and machinery; hosiery; industrial supplies; radios; automobile accessories; mill products; millinery; package products; candy; canvas goods; electrical supplies; shoes; lingerie; shoe findings; batteries; sound equipment; building materials; chinaware; ladies' ready-to-wear; men's wear; paints and varnishes; school supplies; boxes, and many other lines of merchandise.

The Southwest has had a better than normal growth. From 1920 to 1930 (when the last official United States census was taken) population in the area showed an 18.9 per cent increase, while the increase for the entire United States was but 16.1 per cent. Shown according to states the percentage of increase was as follows: Texas, increased 24.9 per cent; Oklahoma, 18.1 per cent; Louisiana, 16.9 per cent, and Arkansas, 5.8 per cent. Of the nine geographical divisions into which the United States Bureau of Census divides the various states the Southwest was second in percentage of increase, being exceeded only by the Pacific Coast.

Due to the rapid development of its large natural resources, the most important of which is petroleum, and to the growth of its industries, the Southwest, during the last decade, has shown a greater increase in buying power than any other section. As a consequence the area now represents approximately one-eighth of the national market. Its population is over twelve million, or 10 per cent of the national population. It produces annually $6,000,000,000 of new wealth, included in which is 19.2 per cent of the value of the country's minerals, 65 per cent of the petroleum, 60 per cent of the natural gas, 100 per cent of the sulphur, 11.4 per cent of the value of farm products, and 50 per cent of the cotton. It has 15 per cent of the country's improved land in farms, 17 per cent of the number of farms, 15.1 per cent of the cattle, 12.3 per cent of the sheep, 13.4 per cent of the railroad mileage, and ships 21.5 per cent of the nation's exports.

Such is the status of the Southwest's industry at present, but of equal or greater importance are the possibilities yet remaining for development in the area. Texas alone, with its fertile soils, timber, minerals and other resources, has room for a vast expansion. Only 15 per cent of its natural resources have been developed, it is estimated, and less than half its tillable land is under cultivation. Being 262,398 square miles in area, Texas is four times as large as New England, and as large as New England plus New York, Pennsylvania, Ohio, Maryland, Delaware, and New Jersey. It has a population of 22.2 persons per square mile, compared with a national average of 41.3 persons per square mile. Should the State of Texas grow in population to 40,000,000 persons it still would be no more densely populated than Ohio.

As the geographic center of the Southwest, merchandise shipped from Dallas has the advantage of a minimum average freight rate. Transportation and communication facilities have been developed to a degree of highest efficiency. Eleven steam railroads and four electric interurbans serve Dallas, in addition to which there are 12 motor bus lines and 41 motor freight lines radiating in all directions. A network of paved highways, air mail and air express lines adds to the distribution system and provides facilities that result in maximum speed in the delivery of merchandise from Dallas to all points in the Southwest.

A well-developed package car system from Dallas provides a freight service to Southwestern cities that in point of speed is almost equal to that of express in many cases.

Passenger train schedules are so arranged that overnight passenger and express service is available to virtually every important point in the area. Motor truck lines handling merchandise in less than carload lots pick up shipments in Dallas at the plant or warehouse and give store-door delivery at destination at no extra cost, thus providing rapid and economical transportation to all points within a radius of 200 miles. Merchandise cars are dispatched at the close of each business day to all important centers.

The fact that Dallas ranks thirteenth among the cities of the United States in total volume of wholesale business, while an outstanding accomplishment, does not tell the entire story with regard to Dallas as a distributing point. The latest Federal census of distribution, completed in 1930, showed that Dallas with more than 500 wholesale houses employing approximately 5000 salesmen, did a $700,000,000 wholesale business that year. Dallas is the chief distribution center in the Southwest for the automotive industry, ranks third in the nation as a distributor of farm implements and machinery and is the largest inland cotton market in the United States, as well as the leading distribution center for cottonseed products. Virtually one-half the country's cotton crop is grown within 12 hours' train ride from Dallas.

That these advantages are recognized by the country's business leaders is borne out by the fact that there are approximately 3000 foreign corporations in the city, and more national concerns have branches in Dallas than in all other Texas cities combined.

Dallas also is widely and favorably known for its retail market, no city of its size boasting of one more complete or attractive. The latest Federal census shows Dallas with 3445 retail stores doing a yearly business of $178,927,224. The same census revealed Dallas as ranking twenty-eighth among the retail markets in the United States in volume of business, and of the 93 cities above 100,000 in population, it is fourteenth in per capita retail sales, surpassing in this respect all other Southern cities.

Facilities for air transportation are of the best. Passenger, mail and express lines operate in all directions, flying regular schedules to the North, East and Pacific Coast. Overnight service is available to Chicago, and less than 24-hour service to New York and Los Angeles. Houston, San Antonio, Tulsa and Oklahoma City are less than two hours away by plane. The United States Department of Commerce rates Love Field, the municipal airport, one of the five best in the country, giving it an ATA designation. Covering 265 acres, municipal and private investments in the field total $1,500,000. Buildings include 13 hangars and two administrative structures. Hensley Field, covering 300 acres, another municipal landing field, is under lease to and operated by the United States War Department.

In postal receipts Dallas ranks twenty-second nationally, totaling $3,307,889 in 1933. Southwestern headquarters for telegraph, telephone and railway express are located here. The city ranks third in telegraph business, including relay business, and twelfth considering local business alone. Dallas is one of the eight regional telephone toll centers. At present it has 68,125 telephone connections, 69,340 electric light connections, 65,412 gas meters, and, within the city limits alone, 60,688 water connections. In railway express business Dallas places first among American cities on a per capita basis, and twelfth in total volume.

A complete service for the handling of tubing or drill stem under pressure

and

Otis Removable Bottom Hole Chokes in diameters ranging from 1" up to 12¼".

THE SOUTHERN STATES COMPANY, INC.

Tower Petroleum Bldg.

Dallas, Texas

One of the Nation's 100 Largest Banks

Resources

More than

$70,000,000.00

Republic National Bank *and* Trust Company

Dallas

DALLAS

As a Manufacturing Center.. Its Office Facilities

AS a manufacturing center Dallas is highly rated, having in excess of 700 factories producing products valued at approximately $175,000,000 annually, and, in normal times, giving employment to 15,000 workers. Dallas is the world's largest manufacturer of cotton gins and cotton handling machinery, and holds like ranking in the manufacture of saddlery, harness and leather goods. Other important products manufactured here include cement, automobile accessories, candy, flour, mixed feeds, petroleum products and oil field supples, bagging, tents, awnings, textiles and clothing, cottonseed products, iron and steel products, cottonseed oil and packing house products.

The United States Department of Commerce, in its last industrial census for Texas reports on Dallas and the value of the various products manufactured. Inasmuch as the Federal Department of Commerce does not make an industrial survey annually, these figures are not representative of business for the last fiscal year. They are, however, the latest available and a fairly accurate idea may be gained from them as to the position occupied by Dallas as a manufacturing center. The figures follow, products being listed alphabetically and not necessarily in the order of their importance, showing name of industry and value of products:

Beverages, $1,301,311.

Bookbinding and blank-book making, $213,515.

Boxes, wooden, $279,795.

Bread and other bakery products, $8,080,607.

Brooms, $289,958.

Canning and preserving: fruits and vegetables, pickles, jellies, preserves, and sauces, $874,039.

Car and general construction and repairs, steam railroad repair shops, $562,412.

Clothing (except work clothing), men's, boy's and youth's, not elsewhere classified, $256,076.

Clothing, women's, not elsewhere classified, $2,409,300.

Clothing, work (including sheep-lined and blanket-lined work coats, but not including shirts), men's, $997,381.

Coffee and spice, roasting and grinding, $1,950,807.

Confectionery, $2,449,184.

Concrete products, $317,127.

Copper, tin, and sheet-iron work, including galvanized-iron work, not elsewhere classified, $619,157.

Engraving, steel and copperplate, and plate printing, $187,613.

Flavoring extracts and flavoring syrups, $4,103,907.

Flour and other grain mill products, $6,058,735.

Food preparations, not elsewhere classified, $722,681.

Foundry and machine-shop products, not elsewhere classified, $9,533,528.

Furniture, including store and office fixtures, $2,265,969.

Ice Cream, $1,076,736.

Ice, manufactured, $1,456,974.

Jewelry, $103,326.

Mattresses and bed springs, not elsewhere classified, $162,591.

Nonferrous-metal alloys and products, not including aluminum products, $97,724.

Oil, cake, and meal, cottonseed, $12,933,979.

Paints and varnishes, $2,007,684.

Patent or proprietary medicines and compounds, $897,262.

Perfumes, cosmetics, and other toilet preparations, 211,854.

Photo-engraving, not done in printing establishments, $247,522.

Planing-mill products (including general mill work), not made in planing mills connected with sawmills, $1,307,-143.

Printing and publishing, book and job, $3,508,993.

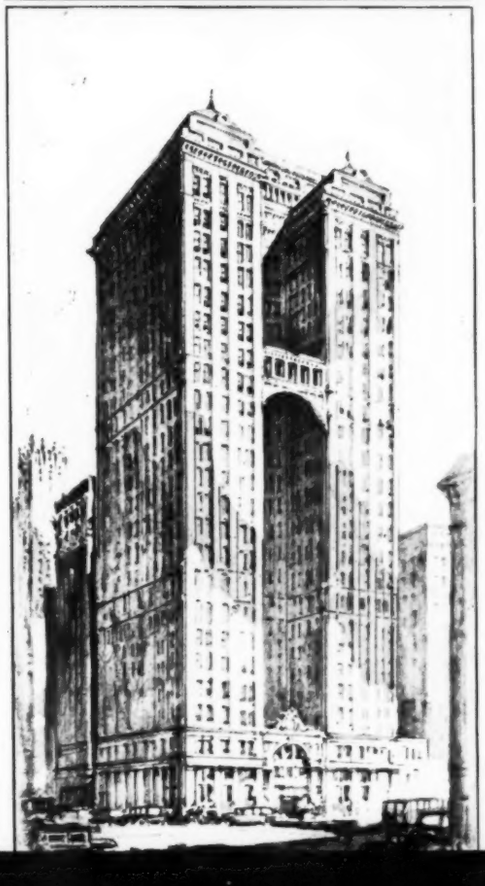
Printing and publishing, newspaper and periodical, $7,-699,453.

Signs and advertising novelties, $570,718.

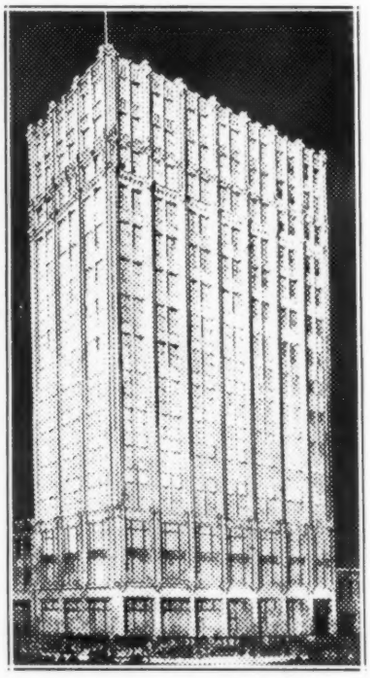
Structural and ornamental iron and steel work, not made in plants operated in connection with rolling mills, $2,602,-261.

Other industries, $89,854,480.

In recent years Dallas has experienced a rapid growth in manufacturing, many plants being established by local capital, as well as by national organizations, to serve the Southwestern market. This show of activity has been brought about by the opportunities available for industries in the section. Economists have said of Texas that it is the last industrial frontier, that it is the last remaining section of the country to offer such wide advantages for manufacturing. Just entering the industrial stage of its development, it is thought probable that the next ten years will see more factories established in Dallas and the entire area than during any previous twenty years of its history. Changed economic conditions have made it necessary for manufacturers to take their production facilities to the population to be served. Manufacturers that in the past have served the entire country from one or two plants, are now finding that the most economical and effective means of attaining national distribution is through regional plants, each so situated as to serve a well-defined market. That Dallas is the center of the Southwestern market, an area of ever-increasing population and one believed to be destined for rapid future expansion, is recog-



Magnolia Building, in which are the offices of Magnolia Petroleum Co. and those of scores of other organizations affiliated with the Petroleum Industry



"GULF STATES" BUILDING

Six Additional Floors And the Air-Cooling of the Entire "Gulf States" Building Will Be Completed Before The Hot Days of Next Summer

The Gulf States Security Life Insurance Company, though only six years old, has in force almost	$40,000,000.00
Has built up admitted assets of nearly	2,500,000.00
Reserves of more than	1,500,000.00
Has already paid to Policyholders and Beneficiaries in cash	1,500,000.00
Increased its policy dividends this year up to	25%
And paid this year a cash dividend on stock of	6%

Safe, Strong, Conservative

Gulf States Security Life Insurance Co.

DALLAS, TEXAS

nized. In addition to its central location Dallas has many local advantages that in the past have appealed to concerns seeking a manufacturing site. The same advantages are existent today and are expected to have their influence in making Dallas a still greater manufacturing center.

Always of prime importance is the cost of industrial sites and buildings. In the outlying districts industrial sites are available at prices ranging from $1,000 per acre up to $1.00 per sq. ft. approaching the down town district. Construction of levees in the Trinity Basin reclaimed for industrial uses 10,000 acres of land near the center of the city. Sites in the district have paved streets, water, power, trackage, gas and all other necessary utilities.

The climate of Dallas is favorable for operations the year around, and its mildness makes it possible to construct industrial buildings at lower costs than where the winters are more severe. Expensive heating systems are unnecessary, thus lowering the maintenance as well as the construction cost.

Those manufacturers not wishing to build their own plants can lease fireproof industrial buildings suitable for manufacturing and warehousing at rates ranging from 20c to 40c per sq. ft. per year, depending largely on the location. Property owners will improve sites to specifications on a rental basis, usually of approximately 6 per cent annual return on the value of the land and 8 per cent on the cost of improvements.

Natural gas is plentiful at moderate rates. This convenient fuel is transported to Dallas from various fields by means of pipe lines. The Dallas Gas Company, supplied from fields of the Lone Star Gas Company, has the franchise for distributing both domestic and industrial gas for the city. Pipe lines of the Magnolia Gas Company terminate at the city limits, industries outside of the city being supplied by either company. Oil, coal and lignite supplement gas as a fuel for Dallas industries.

Electric power is provided within the boundaries of Dallas by the Dallas Power and Light Company. The Texas Power and Light Company serves a large area in eastern Texas adjacent to Dallas and delivers power to the boundaries of the city. The two systems are interconnected to provide reciprocal service. The Texas Power & Light Company was organized in 1912 by Colonel J. F. Strickland. John W. Carpenter, a native son of Texas, is president and general manager of the Company at the present time.

Lake Dallas in Denton County is Dallas' principal source of water supply. This lake was constructed at a cost of $5,000,000 and has a storage capacity of 62,900,000 gallons. The supply is adequate for a population of one million. Auxiliary reservoirs are White Rock Lake, Bachman's Lake and several dams on the Elm Fork and Trinity River. In addition there is available an abundant supply of artesian water from flowing wells in all parts of the Dallas district. In a great many cases this water is used in boilers without treatment, as it forms no dangerous scale. After treatment with the Zeolite process, it is suitable for textile dyeing.

Taxes in Dallas are reasonable and, compared with many cities, extremely low.

Contributing largely to the growth of Dallas industrially are the natural resources in the immediate surrounding territory. In addition to natural gas, coal and oil, already mentioned, these resources include cotton, agricultural products, livestock, valuable mineral deposits, and timber.

Office Buildings

Dallas has especially good office facilities, 28 of the larger buildings make available 2,019,800 sq. ft. of floor area. Limited space does not permit the mentioning of all buildings, and for that reason only those occupied largely by con-

Left: Republic Bank Building, a 20-story structure in which many firms connected with the petroleum industry maintain offices. Right: Tower Petroleum Building, one of Dallas' newer office structures, a majority of concerns having offices in it being engaged in some phase of the oil industry

cerns connected with the petroleum industry are here included.

●

Magnolia Building — Since its erection, in 1921, the Magnolia Building has been a favorite with the oil fraternity. Its 28 floors are almost entirely occupied by petroleum organizations and oilfield supply offices. Located in the center of the downtown business district, its convenience is particularly attractive. From the standpoint of architecture, the Magnolia Building is one of the most beautiful in Dallas. Its appointments are thoroughly modern and offices are arranged to provide the greatest comfort and convenience.

●

Tower Petroleum Building — Sixty-seven independent operators and major oil companies make their Mid-Continent headquarters in the Tower Petroleum Building. Twenty-one stories in height, all offices in the building are outside ones, assuring proper ventilation and lighting. Full-ventilating windows add to the comfort of the occupant; the automatic elevators are remarkably efficient and swift, making 800 feet per minute; and the entire finish of the building is luxurious throughout.

The Tower Petroleum Building is one of the newer office buildings of Dallas. Its architecture is that known as Modern American, beautiful in design, and at the same time efficient. As an unusual feature the owners have furnished quarters for the Geological Library and Assembly Rooms. Special provisions also have been made for laboratories. Special waste carriers, natural gas, compressed air, and forced ventilation are a few of the features provided to facilitate laboratory work.

●

Continental Building — The Continental Building, home of the Continental Supply Company, a five story structure and up-to-date in every respect, is located in the heart of the Dallas business district and in close proximity to the leading hotels.

The first three floors are occupied by the Continental Supply Company, the two upper stories being rented for offices. The building has several novel features. It was one of the first, if not the first, building in this section to be air-cooled throughout. All offices in the building are well appointed and arranged to provide the most favorable working conditions. The front of the building is thoroughly modern in design, the lower portion being faced with black marble.

●

Gulf States Building — One of the most modern of Dallas' office buildings is the Gulf States Building at the northeast corner of Main and Akard Streets, in the heart of the downtown section. Six stories are being added, and the 16-story structure will be air-cooled throughout, thus assuring proper temperature and humidity at all seasons of the year. These factors, together with the ideal location and the fine appointments of the offices themselves, render the Gulf States Building especially attractive to oil companies and the manufacturer of oil field supplies.

"The addition of the extra floors and the air-cooling of our entire home office building is at this time a practical demonstration of our belief that prosperity is soon to be again enjoyed in Texas," Z. E. Marvin, president of the Gulf States Security Life Insurance Company, recently stated.

As present evidence of the return of better business conditions, Mr. Marvin submitted that new business sales of his company for the first nine months of the year exceeded the quota set by the Agency Department for the entire year 1934.

Early in 1934 the company increased its policy dividends approximately 25 per cent and in July of this year, the company's stockholders, numbering approximately 3,500 Texans, received a 6 per cent cash dividend.

●

First National Bank Building — The first floor of the First National Bank Building is occupied by the First National Bank in Dallas, one of the city's leading financial institutions. The remaining 18 floors of this 19-floor structure are occupied by business offices, among which are a goodly number connected with the petroleum industry. Located at 1401-9 Main Street, this building is well situated in respect to nearness to downtown business houses.

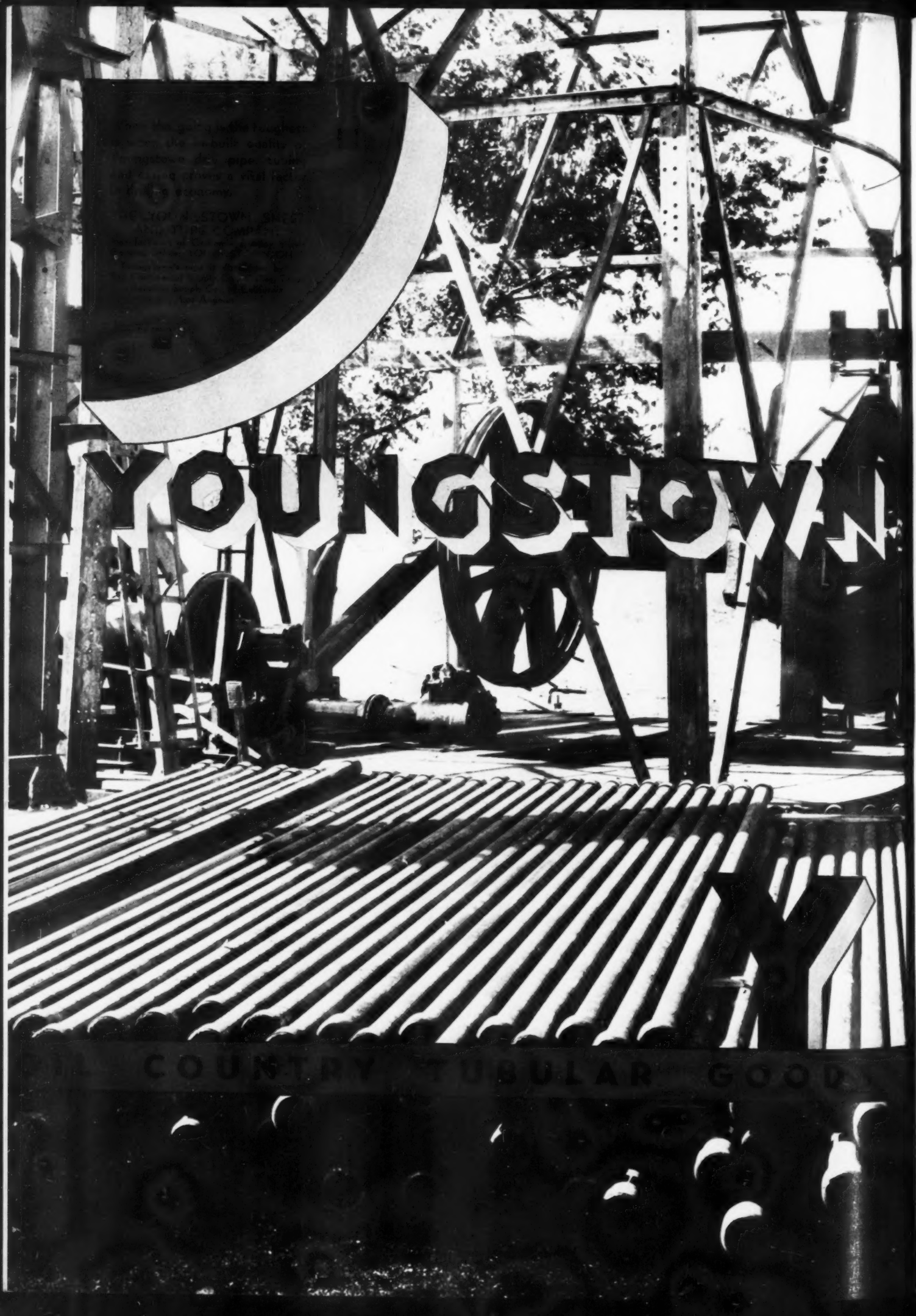
●

Republic Bank Building — Located at 1305-15 Main Street, this building is in the heart of the principal business district. In addition to housing the Republic National Bank and Trust Company, it has 219,000 sq. ft. of rental space for offices. Many firms connected with the oil industry make their headquarters here. The building is a 20-story structure.

THE CONTINENTAL SUPPLY COMPANY

Invites you to visit their offices while attending the A.P.I. meeting in Dallas . . . November 9 to 12-15 inclusive 1934

MEMBER AMERICAN PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION


YOUNGSTOWN
COUNTRY'S TUBULAR GOODS

DALLAS

As a Financial Center

AS the home of eleven state and national banks having a combined capital approximating $18,000,000, as headquarters of the Eleventh Federal Reserve Bank District, six regional or district offices of Federal credit agencies, and the home office of the Texas Bankers' Association, Dallas is the outstanding financial center of the Southwest. Its preeminence is clearly shown by banking statistics. In the matter of bank clearings, and debits to individual accounts, Dallas consistently has held first place among the cities of the Eleventh Federal Reserve Bank District, usually having approximately one-fourth of the total for all reporting cities. These indications of financial strength also frequently show Dallas as being in advance of many cities in the United States having twice its population.

Dallas bank clearings for 1933 were $1,401,170,000, ranking the city as sixteenth nationally; debits to individual accounts were $1,602,176,030, placing Dallas twentieth in the Nation. Bank deposits on June 30 of this year totaled $193,583,201.60, and resources were $224,693,331.66.

Bank clearings have virtually tripled since 1916, when they were $503,832,995. The consistent growth of the Dallas banking structure during the last 40 years is best shown in comparative figures. Five Dallas banks in 1894 had total resources of $4,852,099 and deposits of $3,117,591. On June 30 of this year the eleven banks of the city had total resources of $225,674,710 and deposits of $194,359,263.

Deposits in Dallas banks on June 20 of this year were the highest June totals in the city's history, and the same was true of resources. Following is a comparison of deposits and resources for the past three years:

DEPOSITS

June 30, 1932	$135,395,696.86
June 30, 1933	$134,928,127.72
June 30, 1934	$193,583,201.60

RESOURCES

June 30, 1932	$170,042,330.35
June 30, 1933	$169,046,655.51
June 30, 1934	$224,693,331.66

Deposits and resources, as reported by the various banks as of June 30, 1934, follow:

DEPOSITS

First National	$89,457,112.65
Republic National	$59,597,979.60
Mercantile National	$17,292,001.34
Dallas Bank and Trust	$16,928,606.06
National Bank of Commerce	$ 5,364,394.08
Liberty State	$ 1,849,843.79
Oak Cliff Bank and Trust	$ 1,409,789.81
Texas Bank and Trust	$ 895,425.28
Hillcrest State	$ 569,996.92
Grand Avenue State	$ 218,052.07
	$193,583,201.60

RESOURCES

First National	$103,455,016.10
Republic National	$ 70,558,257.21
Mercantile National	$ 20,179,770.09
Dallas Bank and Trust	$ 18,776,368.37
National Bank of Commerce	$ 5,944,165.74
Liberty State	$ 2,177,028.89
Oak Cliff Bank and Trust	$ 1,615,630.67
Texas Bank and Trust	$ 1,132,007.30
Hillcrest State	$ 604,535.45
Grand Avenue State	$ 250,551.84
	$224,693,331.66

The Dallas Federal Reserve Bank was established in 1914, 20 years ago. The locating of this bank in Dallas did much

First National Bank Building, one of Dallas' largest and finest office buildings

Dallas Branch of the Federal Reserve Bank

to add to the city's prestige and rank in the banking world. Its first statement of December 31, 1914, showed total resources of $8,275,000; on September 26, 1934, the total resources had grown to $199,455,000.

Since the inauguration of the "new deal" by President Roosevelt and his associates millions of additional dollars in credit have been issued by the several Federal credit agencies located here. These include the Federal crop production loan agency, of which Owen Sherrill is manager; the district office of the Reconstruction Finance Corporation, headed by W. P. Andrews; the district office of the Home Owners' Loan Corporation, with James G. Shaw in charge; the district office of the Federal Deposit Insurance Corporation, of which George Sandlie is manager for the Eleventh Federal Reserve District; and the Federal Farm Mortgage Corporation office. The district office of the National Housing Administration also has stimulated and aided credit extension for purposes under the housing act.

Showing Dallas' position in comparison with other cities in the matter of bank clearings and debits, the following statistics have been taken from a report issued by Dun & Bradstreets:

Bank Clearings		Bank Debits	
New York	$157,413,520,000	New York	$148,448,800,000
Philadelphia	$ 12,424,000,000	Chicago	$ 21,939,400,000
Chicago	$ 9,611,744,000	Boston	$ 11,127,600,000
Boston	$ 9,405,283,000	Philadelphia	$ 10,644,500,000
San Francisco	$ 4,684,614,000	San Francisco	$ 6,899,000,000
Pittsburgh	$ 3,794,706,000	Los Angeles	$ 5,590,300,000
St. Louis	$ 2,897,126,000	Pittsburgh	$ 5,477,500,000
Kansas City	$ 2,864,298,000	St. Louis	$ 4,485,400,000
Cleveland	$ 2,530,897,000	Cleveland	$ 3,842,200,000
Minneapolis	$ 2,518,077,000	Detroit	$ 3,807,100,000
Baltimore	$ 2,044,122,000	Minneapolis	$ 3,195,800,000
Detroit	$ 1,940,556,000	Kansas City	$ 2,695,100,000
Cincinnati	$ 1,814,782,000	Baltimore	$ 2,454,000,000
Atlanta	$ 1,503,200,000	Cincinnati	$ 2,442,500,000
Dallas	$ 1,401,170,000	Buffalo	$ 2,065,900,000
Richmond	$ 1,288,377,000	Milwaukee	$ 1,988,200,000
Buffalo	$ 1,206,417,000	New Orleans	$ 1,920,000,000
Houston	$ 1,051,136,000	Washington	$ 1,849,900,000
Omaha	$ 996,877,000	Oakland	$ 1,782,000,000
Seattle	$ 924,977,000	Dallas	$ 1,602,176,000
Louisville	$ 915,949,000	Albany	$ 1,589,100,000
Denver	$ 861,524,000	Hartford	$ 1,454,400,000
Portland	$ 847,349,000	Seattle	$ 1,337,500,000
St. Paul	$ 759,853,000	Houston	$ 1,324,600,000
Washington	$ 618,460,000	Indianapolis	$ 1,225,600,000

(Clearings for Los Angeles not reported.)

The recent banking holiday and the rigid examination required by the Federal government before allowing a bank to reopen were severe tests of the soundness of all banking institutions, and it is to the credit of Dallas and the Eleventh Federal Reserve District that its banks emerged from the storm with such an outstanding record. In the order of their standing, as to the percentage of reopened banks compared with the total number closed by the bank holiday, the figures for each of the 12 reserve districts are as follows: The Dallas, or Eleventh, district, 94.8 per cent; the Kansas City, or Tenth, district, 90 per cent; the Minneapolis, or Ninth, district, 87.7 per cent; the Atlanta, or Sixth, district, 86.8 per cent; the Philadelphia, or Third, district, 85.7 per cent; the Boston, or First, district, 84.7 per cent; the New York, or Second, district, 84.7 per cent; the San Francisco, or Twelfth, district, 84.6 per cent; the St. Louis, or Eighth, district, 81.6 per cent; the Richmond, or Fifth, district, 78.1 per cent; the Cleveland, or Fourth, district, 76 per cent; the Chicago, or Seventh, district, 62 per cent.

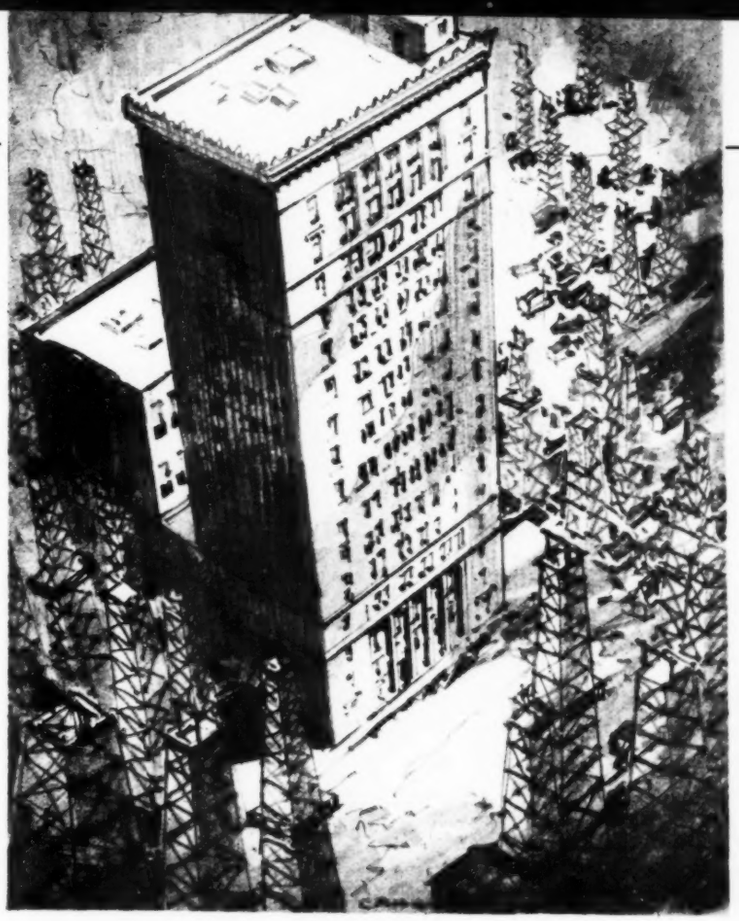
The average for the entire country was 82.6 per cent, thus the Dallas district not only led all other districts, but had a percentage of reopened banks 14.7 per cent above the average for the United States. Only 29 banks out of a total of 565 failed to reopen in the Dallas district. Equally remarkable is the fact that but slightly more than one-half of one per cent of total deposits were tied up in unopened banks.

These figures apply to banks that are members of the Federal Reserve system; however, according to the secretary of the Texas Bankers' Association, data on all banks in the state show virtually the same percentages. There are but 26 banks of all kinds in Texas that have remained closed, and it is expected that a majority of these eventually will be reorganized and reopened.

Closely allied with the financial strength of Dallas is its high position in the insurance field, ranking fourth in importance in the United States. According to the most recent report of the State Board of Insurance Commissioners, there are 111 companies doing business in Texas whose home offices are in the state. All types of companies, stock, mutual, reciprocal, etc., are included, writing all kinds of insurance. Of this number 42 have their home offices in Dallas. There are 33 legal reserve life companies in Texas, 13 having their home offices in Dallas. Assets of all Dallas insurance companies total $95,073,152, with capital of $10,942,000, and surplus of $1,286,550.

In addition to Texas companies, 503 out-of-state insurance concerns operate in the state. More than half, or 255, have their state headquarters in Dallas.

In addition to the writing of all types of insurance, the same companies have made Dallas the most important mortgage loan center in the state, and one of the leading in the country. Not only do Dallas companies loan money on real estate, but many national organizations in the insurance field maintain offices in the city to supervise the lending of money on Texas and Southwestern real estate.



● The First National Bank in Dallas, through sound financing, has played a vital part in the development of the great oil area which it daily serves. In turn, the oil industry has contributed much toward making this bank the largest in the Southwest, with total resources of over a hundred million.

First National Bank
in Dallas

DALLAS...

As a City in Which to Live

DALLAS is frequently referred to as the ideal city in which to live. Its beautiful residential sections, excellent educational opportunities, healthful climate with mild winters, and varied recreations and amusements are attractive. The people of Dallas have a reputation for friendliness and hospitality, a trait invariably commented upon by the newcomer.

One of the outstanding features of the city is its cleanliness. Although an industrial center and having a large number of factories, Dallas is not a smoky, grimy place, as might be supposed. This is due to the fact that most of the industrial concerns use natural gas as a fuel, or electrical power. Such cleanliness makes it possible for office buildings and homes to be constructed of stone, terra cotta and other light-colored materials with the assurance that they will remain bright and fresh in appearance.

Climate

Indicative of Dallas' appealing climatic conditions, a few facts might well be cited. Data, based on average weather reports covering a period of 30 years, show the following:

Average temperature, January, 45.1 deg.; average temperature, July 84; average temperature, annual, 65.

Maximum monthly precipitation, April, 4.24 in.; minimum monthly precipitation, February, 2.40 in.; average annual precipitation, 37.97 inches.

Wind velocity (average for 12 years), 8.3 miles per hour.

Humidity (average for 12 years), at 12 noon, 51 per cent.

Days between killing frosts (average for 12 years), 245.

Altitude, 510 feet.

During the summer months breezes from the Gulf of Mexico, combined with low humidity, result in a dry, pleasant and invigorating climate. Rarely is there an absence of a cooling breeze at night. The winters are especially mild, and golf and other outdoor sports can be engaged in the year 'round.

Churches

Dallas boasts of its religious leadership. There are more than 300 churches in the city with a combined membership in excess of 125,000. Its many beautiful church buildings represent an investment of millions of dollars. Among its pastors are included several of national and international reputation.

Educational Facilities

An excellent system of public and preparatory schools, as well as Southern Methodist University and the Baylor College of Medicine, provides a cultural background for the citizens of Dallas. Graduates of public and preparatory schools are admitted to all colleges and universities of Grade A ranking.

There are seven high schools—Woodrow Wilson, Highland Park, Technical, Forest Avenue, Oak Cliff, Sunset, and North Dallas.

Forty-five elementary schools make up the public school system, in addition to which there are schools of elementary grade in Highland Park and University Park.

Among the private schools are the Miss Hockaday School for Girls, Terrill School for Boys, Ursuline Academy for Girls (Catholic), and the North Texas Peacock Military Academy.

Southern Methodist University, with an enrollment of approximately 1700 students, is recognized as one of the leading educational institutions of the country. Besides offering courses leading to B.A., M.A., and Ph.D. degrees, specialized training is provided in engineering, journalism, law, music, theology, commerce and education. The College of Arts and Sciences of the university also offers a pre-medical course that qualifies for entrance into any medical school in the United States.

Baylor University, organized in 1845, under the Republic of Texas, has maintained its professional scientific schools in Dallas for the last 30 years. These schools consist of the College of Medicine, College of Dentistry, the School of Nursing, a free charity teaching clinic, and Baylor University Hospital. The College of Medicine and the College of Dentistry are the largest of their kind west of the Mississippi and south of the Missouri rivers.

The Miss Hockaday School for Girls, for many years one of the outstanding preparatory schools in the country, two years ago organized the Hockaday Junior College, giving two years of college work. Graduates of this are admitted without examination

The 1935 Model
Derrick and Rig Front

TANKS
HOUSES
STEEL
DERRICKS

WELDED TANK AND STEEL CO.

Office Burt Building — Phone 7-1513
DALLAS, TEXAS

Warehouse: Greggton, Texas
Phone: Longview 1464

PATENTS OBTAINED FOR INVENTORS
JACK A. SCHLEY
U. S. PATENT LAWYER
1807-11 Tower Petroleum Bldg., DALLAS
35 YEARS' EXPERIENCE
Practice before U. S. Courts and Patent Office

GENERAL OFFICES: PHILADELPHIA, PA.

SUN OIL COMPANY

SOUTHWEST DIVISION

SUNOCO
MERCURY MADE
MOTOR OIL

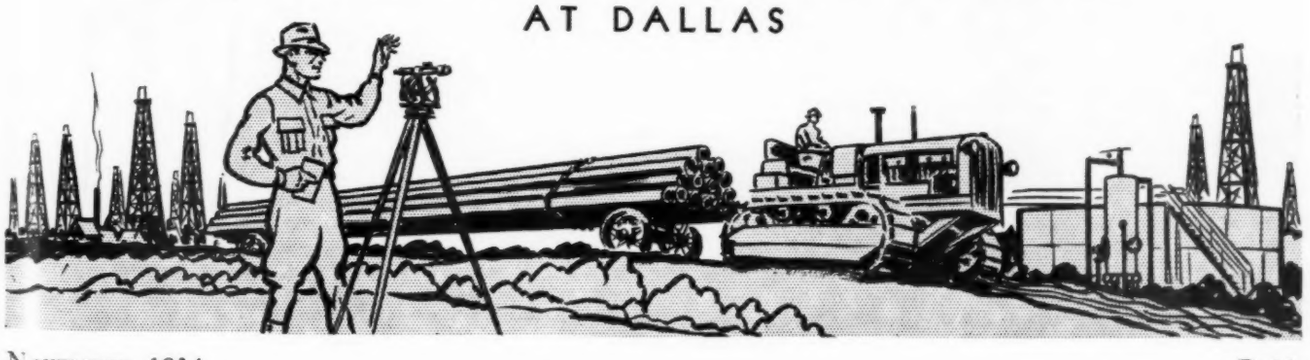
FIRST NATIONAL BANK BUILDING

DALLAS, TEXAS

THE location of Dallas as a geographic center of oil activity was a factor in the city's selection for the important A. P. I. convention. That very location has enabled us to give extensive banking service to the Petroleum industry in its phases of production, refining and marketing.

MERCANTILE NATIONAL BANK

AT DALLAS



Only ONE can be first

It takes something *Extra* to make a Champion

FOUR swimmers, or a dozen, start from scratch. But ONE strokes his way to victory! He's got to have something "extra" . . . something a little better than the rest.

Wherever oil is used, Gargoyle Lubricants occupy a dominant position. Year in and year out, this world-famous line of oils and greases continues to establish new records for savings in POWER, LABOR, MATERIALS and OIL. In many instances these savings have been great enough to offset an entire year's oil bill.

A Magnolia Lubrication Specialist can show you records established in plants similar to your own. It will pay you to check up now.

Get the *Extra Safety* of GARGOYLE

Lubricating Oils

MAGNOLIA

PETROLEUM COMPANY

NRA MEMBER U.S. WE DO OUR PART

General Offices . . . Dallas, Texas

Wholesale Agencies and Stocks Throughout Texas, Oklahoma, Arkansas, Louisiana and New Mexico.

A SOCONY-VACUUM COMPANY

200,000 Texans Turn Their Backs

We know about 200,000 men in Texas who lean back in winter and take their ease; they shift their heat problems to a small lever, and turn their backs on building fires. These are the customers along the Lone Star network of natural gas lines, in 255 towns. And when they use the new-type man's-size heaters, they are especially comfortable. Have you seen these modern enclosed heating units, the Floor Furnaces, Steam Radiators and Circulator Heaters? They work like furnaces, and the firebox vents out the flue.

A. P. I. Visitors, Welcome!

Dallas has been running with natural gas for nearly 25 years, as you will know when you see its famous sparkling skyline.

LONE STAR GAS CO.

Producers and Transporters of Natural Gas

Scene along Turtle Creek Boulevard, Dallas

to the junior classes of the leading women's colleges of the country, such as Vassar, Smith and Wellesley.

The Terrill School for Boys was established in 1906 by Mentor B. Terrill. It is located in the heart of East Dallas. For many years the Terrill School has offered fourth and fifth grade work in addition to junior and senior high school courses.

The only private military school in Dallas is the North Texas Peacock Military Academy. While established in Dallas as late as 1930, the original Peacock Military Academy was founded in San Antonio in 1894 by Prof. Wesley Peacock, whose oldest son, Major Wesley Peacock, Jr., is now superintendent of the school there.

Recreation and Amusements

An elaborate system of parks and playgrounds offers a wide variety of recreational facilities. The city park system consists of 50 parks covering in excess of 4000 acres. Tennis courts, swimming pools, baseball diamonds and other facilities are provided in each. During the summer months free motion picture shows and band concerts are provided.

Sixteen golf courses are located in the vicinity of Dallas, including private, municipal, and a few semi-public courses where the membership fee is nominal. Three excellent 18-hole courses are maintained by the city: Tenison Park, Stevens Park and Oak Grove. The principal country clubs are the Dallas Country Club, Brook Hollow Country Club, Lakewood Country Club, Cedar Crest Country Club and Glen Lakes Country Club.

The Dallas Polo Club has excellent grounds, clubhouse facilities and stables. There are also a number of riding stables where horses may be had for hire and where privately-owned horses may be boarded.

Besides its many country clubs Dallas has the Dallas Athletic Club, the City Club, the University Club, the Dallas Woman's Club, the Dallas Federation of Women's Clubs, the Columbian Club, the Idlewild and Terpsichorean clubs.

White Rock Lake provides excellent facilities for all forms of water sports. Its bathing beach is one of the best, and speedboat racing and sailing are favorite pastimes. Lake Dallas, in Denton County, affords boating, fishing and duck shooting.

Theaters, Music and Art

With 40 theaters, many of them magnificent structures, Dallas offers the latest and best in motion pictures, vaudeville and stage productions. The Municipal Auditorium at Fair Park presents many road shows, Grand Opera, musical attractions and similar events. The Dallas and Oak Cliff Little Theaters present worthwhile attractions each season. The Dallas Symphony Orchestra is one of the leading musical organizations of the Southwest. The Dallas Art Association maintains the Dallas Museum of Fine Arts in the Dallas Power & Light building, and the Highland Park Art Gallery is in the Town Hall of Highland Park. Both are open to the public.

Civic Clubs and Organizations

Leading civic clubs include the Dallas Chamber of Commerce, Rotary, Kiwanis, Lions, Advertising League, Technical Club, Electric Club, Traffic Club, Salesmanship Club, Dallas County Medical Society, the Community Chest, and numerous other similar organizations.

The Y. W. C. A. occupies a downtown home completed a few years ago at a cost of $500,000, and the Y. M. C. A. comparatively recently erected a downtown building and a branch in Oak Cliff, representing an expenditure in excess of $1,000,000.

The Dallas Public Library has its main building in the downtown district, and several outlying branches are maintained. Highland Park has a public library in the Town Hall.

Dallas has numerous splendid residential districts. Accommodations are offered for the wage earner, the salaried employe, or the executive of considerable means wishing the highest type of surroundings for his family. Highland Park, with its winding drives, beautiful parks, and distinctive architectural designs, is one of the most beautiful residential sections to be found anywhere in the United States. Other restricted residential districts noted for their beauty are Munger Place, Country Club Estates, Greenway Parks, University Park, Greenland Hills, Perry Heights, Kessler Park and Greenville Crest. Many new apartment buildings have been erected within recent years.

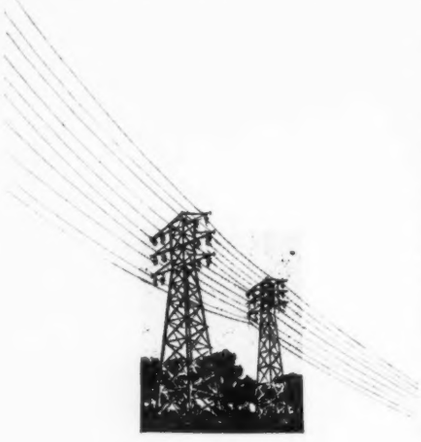
Home of F. H. Penn, Preston Road, Dallas

1836

1936

© Frank Rogers, Dallas

On the Wings of a Century



When Texas celebrates in 1936, we shall be on the eve of our Quarter-Century Celebration. Organized in 1912 by Texans, manned and managed by Texans, we are proud of the part we have played in the development of Texas.

We are pioneers in dependable transmission line electric power and light service. At first we served only 13 towns, and now over 300 . . of which number 137 had no previous electric service. During all this period electric lighting rates have been consistently lowered and service extended to many farms and rural homes.

We eagerly anticipate the opportunities of the future . . a great Texas today . . and an infinitely greater Texas tomorrow. We rededicate ourselves to the work of meeting the needs of a progressive Texas . . *always*.

WHEN the immortal Sam Houston led his courageous army of footsore but determined pioneers across the trackless wilderness and onto the plains of San Jacinto, he had dreams of an empire. He heard the tramping feet of the multitudes of community builders to follow. He envisioned the transformation of a dark frontier into a commonwealth of happy, progressive, prosperous millions.

How fully this dream has come true! How much a prophet time has proved the "Talleyrand of the Brazos!"

On the wings of a century Texas has flown even beyond the high mark set for it by its hardy pioneers. The few thousand inhabitants have grown into six millions; the few trading posts have become the teeming centers of commerce; the virgin forests and prairies have been turned into fields of matchless productivity.

It is proper and fitting that all Texans should join in the celebration of the state's triumphs in the first century of her history . . . and in pointing the direction and setting the pace for new objectives in the years to come. Texas is great in history, great in natural resources, great in the calibre of its people.

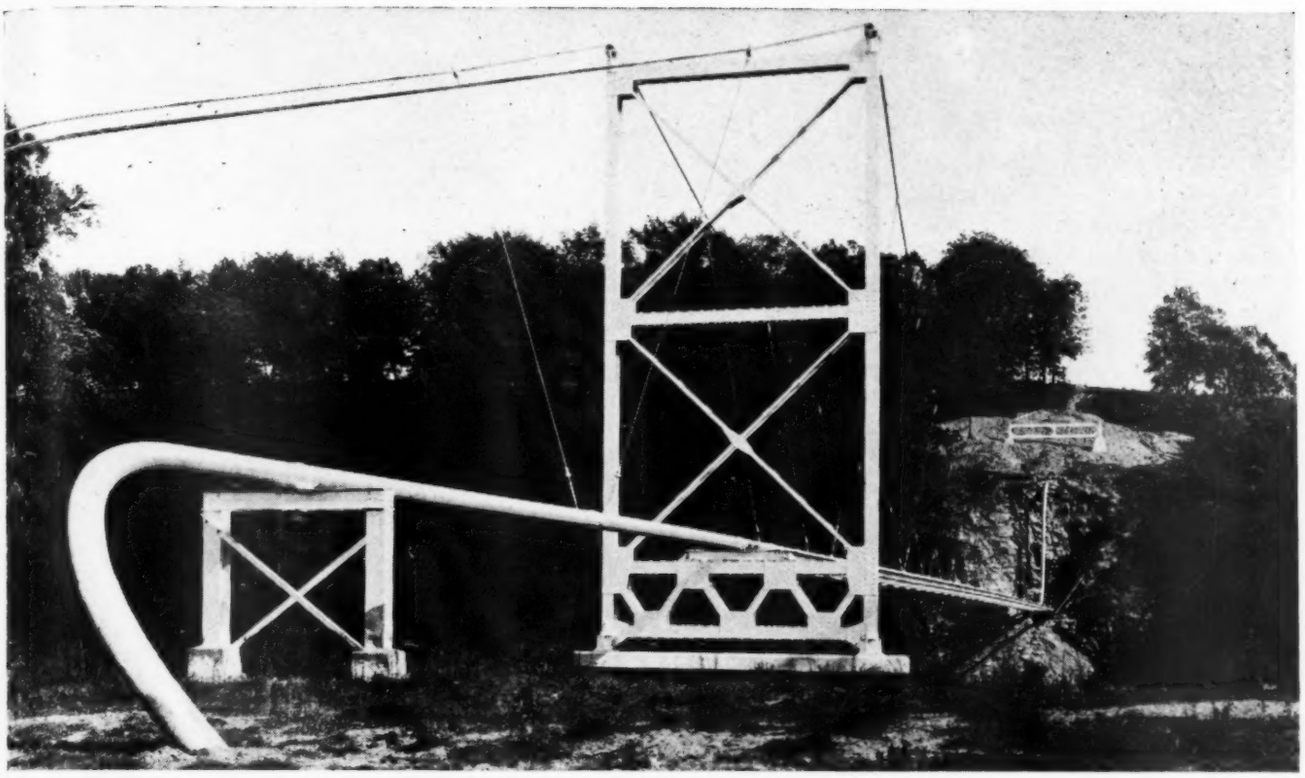
Texans, Let's Talk Texas Centennial!

The Texas Centennial should be marked by a celebration in every way equal to all this greatness. A forward-looking people should pause to reflect on past achievements and thereby get fresh inspiration for greater achievements in the future.

The year 1936 can be as great in the destiny of the Lone Star State as was the year 1836. Texans today have the same courage, vision and singleness of purpose as characterized those lion-hearted first settlers who gave their all to the founding of a new empire.

The eyes of the world were on Texas in 1836. The eyes of the world are upon us today.

TEXAS POWER & LIGHT COMPANY



View showing the unsymmetrical suspension span of 340 ft. from center to center of the two main towers

Pipe Line Bridge with Unsymmetrical Suspension Span

by

Wilder Kenan,
of Matthews & Kenan
Consulting Engineer
San Antonio, Texas

TO safeguard against periodic floods and corrosion hazards, a natural gas pipe line suspension bridge has been built above and across the Iowa River for the United Light and Power Company at a point near North Liberty, Iowa. The 10-in. line supplies natural gas to domestic and industrial consumers of Cedar Rapids, Iowa.

The bridge, although comparatively small, is, nevertheless, an interesting structure, due to the physical characteristics of its location that resulted in a somewhat unusual adaptation of the suspension principle in its design. At this point, the Iowa River has a high and precipitous rock bluff bank on one side and a low soil bank on the opposite, the level differential between the opposing banks being approximately 60 feet. By taking full advantage of the peculiarities of the location in the design of the structure an actual saving in the cost of the bridge resulted. In order that one of the main piers, supporting a main tower, could be located on the brow of the high rock bluff bank, thereby obtaining an inexpensive pier as well as a low and economical tower, an unsymmetrical suspension span of 340 ft. from center to center of the two main towers was adopted, with 300 ft. of the total suspension span carrying a useful suspended load and the remaining 40 ft. of the span adjacent to the main tower on the high bank side free of suspended loading. This feature is shown in one of the accompanying photographs. The author first used an unsymmetrical suspension span of this same nature and for the same reason in the design of the Platte River pipe line suspension bridge located near Fremont, Nebraska, owned by the Northern Gas and Pipe Line Company and completed in the spring of 1931. In this case the level differential between the opposing banks is approximately 170 ft., and 780 ft. of the 1000-ft. single span carries a useful suspended load.

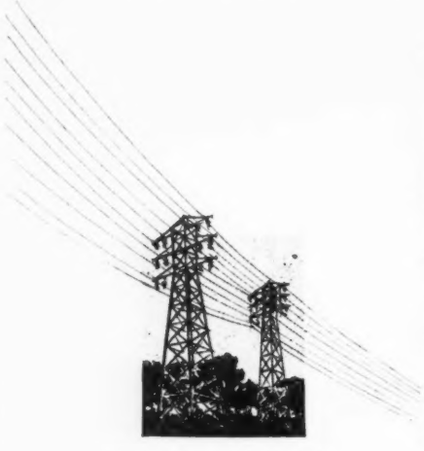
On the high bluff bank side the main pier, supporting a main tower four ft. in height, consists simply of two reinforced concrete pedestals. The main pier on the opposite low bank side consists of a reinforced concrete pier, of the dumbbell section type, superimposed on two 4½-ft. diameter reinforced concrete shafts that extend from the normal ground surface down to solid rock approximately 22 ft. below, to which they are securely keyed and dowelled. The top of this pier, ten ft. above normal ground surface, supports a main tower 42 ft. in height. The two main towers of the bridge are fabricated from structural steel shapes and have their bases fixed to the pier tops; all tower top movement caused by elongation and contraction of the main cable backstays from temperature changes being provided for by the flexibility of the main tower columns. The elevation differential between the two opposing main tower tops is 15 feet. The two main cables of the bridge are each of 1⅜-in. diameter galvanized steel manufactured bridge cables, having independent wire rope centers. The breaking strength of each main cable is 150,000 lb. and a factor of safety of three was employed in their design. These main cables were prestressed

1836

1936

© Frank Rogers, Dallas

On the Wings of a Century



When Texas celebrates in 1936, we shall be on the eve of our Quarter-Century Celebration. Organized in 1912 by Texans, manned and managed by Texans, we are proud of the part we have played in the development of Texas.

We are pioneers in dependable transmission line electric power and light service. At first we served only 13 towns, and now over 300 . . of which number 137 had no previous electric service. During all this period electric lighting rates have been consistently lowered and service extended to many farms and rural homes.

We eagerly anticipate the opportunities of the future . . a great Texas today . . and an infinitely greater Texas tomorrow. We rededicate ourselves to the work of meeting the needs of a progressive Texas . . *always.*

WHEN the immortal Sam Houston led his courageous army of footsore but determined pioneers across the trackless wilderness and onto the plains of San Jacinto, he had dreams of an empire. He heard the tramping feet of the multitudes of community builders to follow. He envisioned the transformation of a dark frontier into a commonwealth of happy, progressive, prosperous millions.

How fully this dream has come true! How much a prophet time has proved the "Talleyrand of the Brazos!"

On the wings of a century Texas has flown even beyond the high mark set for it by its hardy pioneers. The few thousand inhabitants have grown into six millions; the few trading posts have become the teeming centers of commerce; the virgin forests and prairies have been turned into fields of matchless productivity.

It is proper and fitting that all Texans should join in the celebration of the state's triumphs in the first century of her history . . . and in pointing the direction and setting the pace for new objectives in the years to come. Texas is great in history, great in natural resources, great in the calibre of its people.

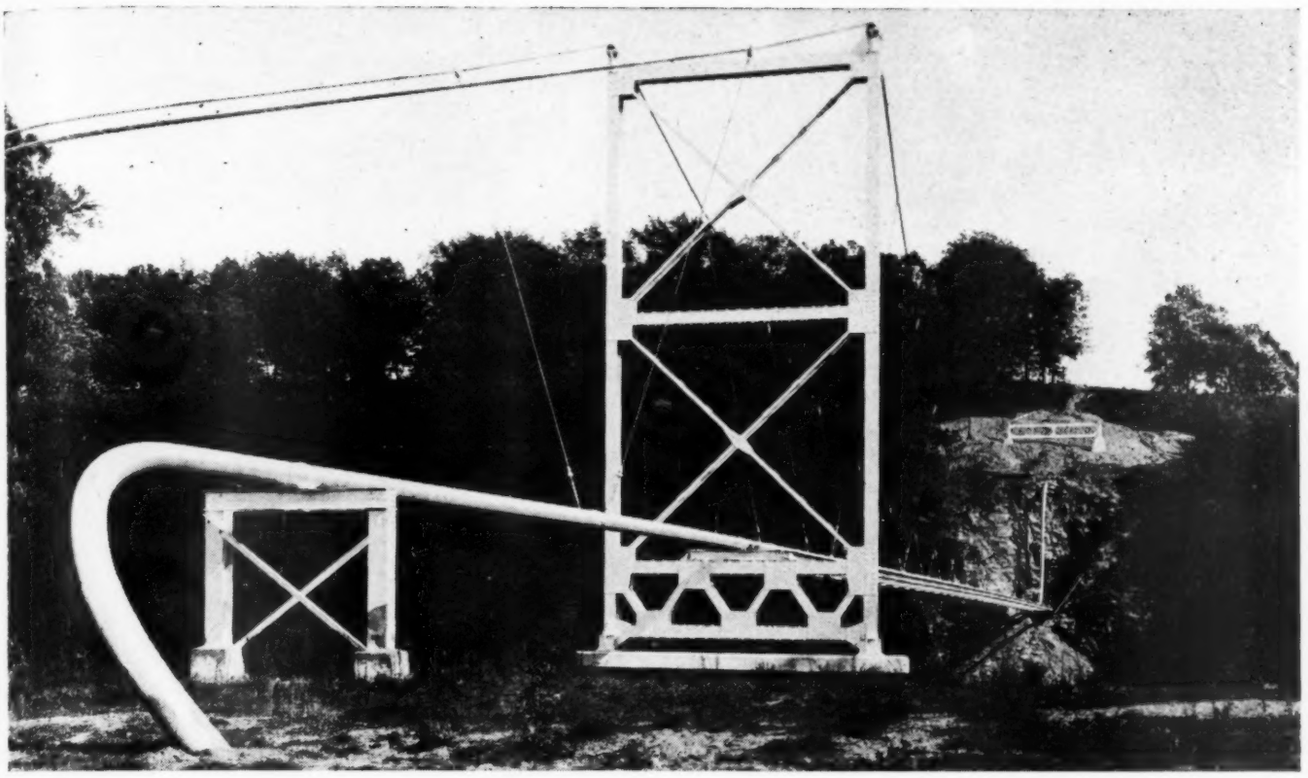
Texans, Let's Talk Texas Centennial!

The Texas Centennial should be marked by a celebration in every way equal to all this greatness. A forward-looking people should pause to reflect on past achievements and thereby get fresh inspiration for greater achievements in the future.

The year 1936 can be as great in the destiny of the Lone Star State as was the year 1836. Texans today have the same courage, vision and singleness of purpose as characterized those lion-hearted first settlers who gave their all to the founding of a new empire.

The eyes of the world were on Texas in 1836. The eyes of the world are upon us today.

TEXAS POWER & LIGHT COMPANY



View showing the unsymmetrical suspension span of 340 ft. from center to center of the two main towers

Pipe Line Bridge with Unsymmetrical Suspension Span

by

Wilder Kenan,
of Matthews & Kenan
Consulting Engineer
San Antonio, Texas

TO safeguard against periodic floods and corrosion hazards, a natural gas pipe line suspension bridge has been built above and across the Iowa River for the United Light and Power Company at a point near North Liberty, Iowa. The 10-in. line supplies natural gas to domestic and industrial consumers of Cedar Rapids, Iowa.

The bridge, although comparatively small, is, nevertheless, an interesting structure, due to the physical characteristics of its location that resulted in a somewhat unusual adaptation of the suspension principle in its design. At this point, the Iowa River has a high and precipitous rock bluff bank on one side and a low soil bank on the opposite, the level differential between the opposing banks being approximately 60 feet. By taking full advantage of the peculiarities of the location in the design of the structure an actual saving in the cost of the bridge resulted. In order that one of the main piers, supporting a main tower, could be located on the brow of the high rock bluff bank, thereby obtaining an inexpensive pier as well as a low and economical tower, an unsymmetrical suspension span of 340 ft. from center to center of the two main towers was adopted, with 300 ft. of the total suspension span carrying a useful suspended load and the remaining 40 ft. of the span adjacent to the main tower on the high bank side free of suspended loading. This feature is shown in one of the accompanying photographs. The author first used an unsymmetrical suspension span of this same nature and for the same reason in the design of the Platte River pipe line suspension bridge located near Fremont, Nebraska, owned by the Northern Gas and Pipe Line Company and completed in the spring of 1931. In this case the level differential between the opposing banks is approximately 170 ft., and 780 ft. of the 1000-ft. single span carries a useful suspended load.

On the high bluff bank side the main pier, supporting a main tower four ft. in height, consists simply of two reinforced concrete pedestals. The main pier on the opposite low bank side consists of a reinforced concrete pier, of the dumbbell section type, superimposed on two 4½-ft. diameter reinforced concrete shafts that extend from the normal ground surface down to solid rock approximately 22 ft. below, to which they are securely keyed and dowelled. The top of this pier, ten ft. above normal ground surface, supports a main tower 42 ft. in height. The two main towers of the bridge are fabricated from structural steel shapes and have their bases fixed to the pier tops; all tower top movement caused by elongation and contraction of the main cable backstays from temperature changes being provided for by the flexibility of the main tower columns. The elevation differential between the two opposing main tower tops is 15 feet. The two main cables of the bridge are each of 1⅜-in. diameter galvanized steel manufactured bridge cables, having independent wire rope centers. The breaking strength of each main cable is 150,000 lb. and a factor of safety of three was employed in their design. These main cables were prestressed

by the manufacturer, in accordance with the specifications, for the purpose of removing all structural stretch by increasing their modulus of elasticity from approximately 12,000,000 lb. per sq. in. after manufacture to approximately 20,000,000 lb. per sq. in. after prestressing. These main cables assume a parabolic curve between main towers after loading, the mid-point deflection being 30 ft. for the basic design temperature of 50 deg. fahr.—this basis temperature being assumed in the design due to the bridge being constructed during the winter months. The main cables change their direction over the main tower tops in the snug-fitting grooves of cast-steel cable saddles that are affixed to the main tower column tops. These grooves have a radius of 30 in. to provide an easement in the change of direction of the cables to avoid excessive bending stresses. From these tower-top cable-saddle castings the main cables extend downward at an angle of approximately 21 deg., with the horizontal as straight backstays to the concrete anchorages to which they are affixed with provision for accurate adjustment.

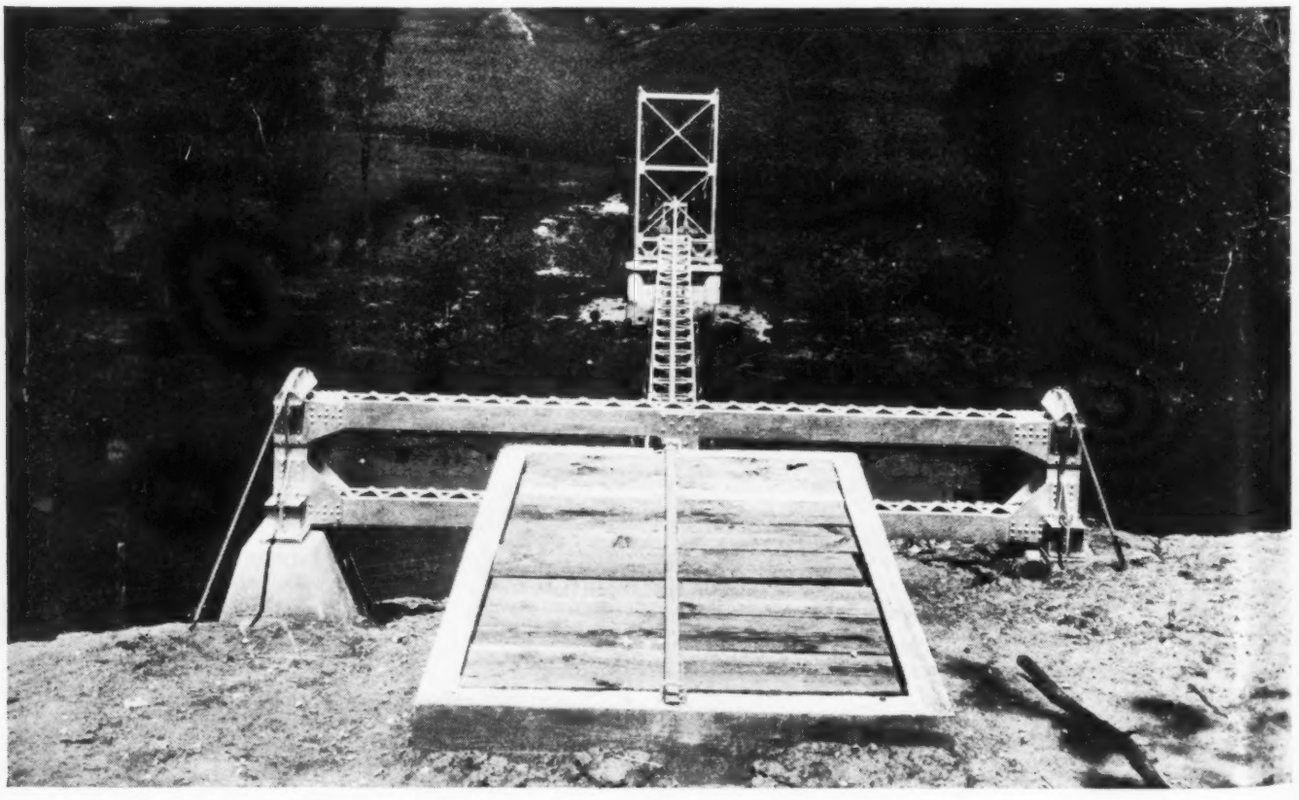
Suspended from the main cables by means of pairs of $\frac{5}{8}$-in. diameter galvanized steel manufactured strand suspenders, equipped with turnbuckles for adjustment at their lower ends, along with the necessary connecting sockets, there is a horizontal wind stiffening truss designed and fabricated of structural steel shapes, which, in addition to providing lateral stability and rigidity against lateral wind pressure, also supports the pipe line along its longitudinal center-line. The mid-point upward deflection or camber of this stiffening truss is one ft. at 50 deg. fahrenheit. The length of the stiffening truss is 300 ft. from end to end, each end of which is provided with a structural steel tie-down slip clamp that allows the truss to expand and contract freely without the possibility of lateral or vertical movement. One end of this stiffening truss is supported on a horizontal member of the main tower on the low-bank side, whereas the opposite end is supported on a concrete rest block located in a seat that was recessed back into the face of the rock bluff bank by blasting.

To support the pipe line back beyond the main pier on the low bank side for a distance of 60 ft., where the natural ground surface is above extreme high water, a structural steel bent was designed. This bent consists of two 8-in. by 31-lb. steel H-sections that were driven to rock, spaced six ft. apart transversely with the longitudinal center-line of the bridge, their tops then being cut off approximately six ft. above normal ground surface. These driven steel columns of the bent were capped and sway-braced with structural steel shapes. Midway between the main pier and this bent the pipe line is supported by suspenders from the main cable backstay attached to the pipe line by means of a structural steel collar designed to permit adjustment of the supporting suspender lengths.

All structural steel of the structure, as well as the pipe line, received a final field coat of aluminum paint. As a result of the adoption of the bridge type of crossing, the pipe line is at all times subject to thorough inspection and maintenance; and the maintenance of the entire crossing structure during the years to come will consist almost entirely of a periodic repainting of the structural steel and the pipe line.

The bridge was designed by the firm of Matthews & Kenan, Consulting Engineers, of San Antonio, Texas, and was constructed by the Pittsburgh-Des Moines Steel Company, of Des Moines, Iowa, who likewise fabricated all structural steel for the bridge in its Des Moines plant. The main cables, suspenders, and all cable fittings were manufactured and furnished by the American Steel and Wire Company.

View of bridge from the high-bank side of the river. Main tower four feet high, in foreground



Some Economic Aspects of Gas Solubility Investigations*

By
ALEXANDER B. MORRIS
Petroleum Engineer
Tulsa, Oklahoma

STUDIES such as the investigations into the solubility of gases in crude oil under various conditions, which have been carried on during the past three or four years, are very interesting from an academic point of view, but this consideration alone is hardly sufficient to warrant the large contributions from the industry necessary to maintain them. Some definite benefit to the industry as a whole should be forthcoming. The purpose of this paper is to direct the attention of company engineers, and company executives, to some of the ways in which the information gained from these studies can be made directly profitable.

This work has two principal economic aspects. One affects the investment budget, and through it the financial requirements of the companies. The other affects operations, and through this course is reflected in current earnings. It will be shown that, as a direct result of the investigations into gas solubility, undertaken in the recent past by various investigators, it is now possible:

1. To determine more accurately the amount of reservoir oil originally present.
2. To obtain closer control on operating conditions, to effect more economical recovery.
3. To predict earlier and more dependably when and how much surface lifting equipment will be needed.
4. To reduce, or entirely avoid the very large investment in gasoline recovery equipment now frequently found necessary.
5. To control the gravity of the pipe line oil so as to secure the greatest possible revenue from the products of the well.
6. To effect the recovery of a large amount of gasoline now wasted while the practicability of a gasoline recovery system is being decided.
7. To plan operations, by comparison with the history of old properties operated without this new informaton, so as to avoid the mistakes of ignorance made in the past.

These points will be discussed in the following pages, though not necessarily in the order stated. There is so much overlapping of the points themselves, and of the data from which they have been drawn as conclusions, that to treat them in any particular order would require tiresome repetition of many of the facts presented. It was more practical to present the data in as concise a form as possible, pointing out during its discussion its application to the primary purpose of this paper.

During the past three or four years much time and labor have been expended[1†] in efforts to determine the solubility of natural gas in crude oil, under various conditions of pressure and temperature. The early attempts resulted in conclusions which were apparently considerably at variance, and it was not until Lindsly's work,[2] with Oklahoma City and several California crude oils that definitely consistent results were attained. Lindsly pointed out that the apparent differences between the findings of these earlier investigators resulted from a failure on their part to duplicate natural conditions by choosing as working media gases containing no condensible components and oils containing none of the lighter fractions, including permanent gases.

By securing well-head and bottom-hole samples of oil with the gas actually in solution at the pressures prevailing at the sampling points, working media were obtained which contained all components from the lightest to the heaviest, in their natural proportions. By liberating this dissolved gas in pressure steps, and analyzing each cut liberated, it was possible to construct curves for each of the crude stocks chosen, which showed the amounts of the "gas" components remaining in solution at each pressure. Lindsly's results, at the same time that they provide much new material for study, reconcile the varying conclusions of the other investigators in this field by pointing out the reasons for their differences.

The practice of taking bottom-hole samples early in the life of a well, and periodically thereafter, provides information as early as the second sampling, for determining with a degree of reliability never heretofore even approached, the total amount of oil originally present in the reservoir. It provides numerical values for several of the constants in Coleman's formula.[3] The study of cores has had its emphasis changed. The role of porosity as a measure of reservoir space, appears to be less significant than permeability. Pressure studies of the gas released from solution by differential liberation[4] show the amount of natural energy available for recovering the oil; and analyses of the several cuts show the composition of the gas that may be expected to be present in the gas cap at any lower pressure.

With this information it is now possible to appraise a pool within a few months of its opening, determining not only the quantity of oil in the reservoir but obtaining at the same time a guide to development and production programs. The validity of these results is impaired by the presence of water drive as a source of energy; so that where this condition exists, its effect must be compensated for in the calculations. Unfortunately, complete information on the extent of water drive is never available until too late in the life of a field to be of any particular value. Where, however, there is no evidence of water drive, Coleman's formula and the values of the constants furnished by bottom-hole sampling yield very satisfactory results. The approximate date upon which wells will cease natural flow can be closely set for any given production rate, and the production rate resulting in the most economical recovery can be determined. The amount and kind of lifting equipment can be closely estimated long before it is needed, thus avoiding large emergency expenditures to keep the wells on production.

The study of the analyses of the gas released from solu-

*Paper presented before the Petroleum Division of the A.I.M.E. at Tulsa, Oklahoma, October 12, 1934.

†References are at the end of the paper.

TABLE I

Solubility of Gas and Estimate of Solubility based on Complete Saturation of Reservoir Oil, at 149 deg. fahrenheit. (Portion of Table 3, from Lindsly's Report of Experiments on Bottom-hole Sample at Crescent, Oklahoma).

Pressure, Lb. per Sq. In. Abs.	Total Gas		Estimate Based on Complete Saturation at 2829 lb. per sq. in. Abs.			
	In Solution Cu. Ft. per Bbl. Residual Oil	Liberated Cu. Ft. per Bbl. Residual Oil	In Solution Cu. Ft. per Bbl. Initial Oil	Liberated Cu. Ft. per Bbl. Initial Oil	In Solution Cu. Ft. per Bbl. Residual Oil	Liberated Cu. Ft. per Bbl. Residual Oil
2829			642.10	00.00	877.00	00.00
2575	814.03	00.00	589.53	52.17	814.03	72.97
2144	678.99	135.04	492.06	150.04	678.99	208.01
1666	551.87	262.16	399.94	242.16	551.87	335.13
1223	442.95	371.08	321.01	321.09	442.95	444.05
813	319.60	494.43	231.61	410.49	319.60	567.40
354	184.44	629.99	133.37	508.73	184.44	702.56
101	102.62	711.41	74.37	567.73	102.62	784.38
14	00.00	814.03	0.00	642.10	00.00	887.00

tion at various pressures below initial reservoir pressure will also reveal when and to what extent a gasoline plant in the field would be practicable. Lindsly's work at Oklahoma City and at Crescent, Oklahoma[3] furnishes data, further discussed below, which indicates that with proper facilities for receiving the oil from the well, a large part or even all of the gasoline plant equipment now generally considered necessary can be avoided.

The ability to make such determinations early in the life of a field is of great value to the executives responsible for providing funds for development and operation. If a sale of an interest in a property is contemplated, estimates of value can be made which are free from many of the elements of uncertainty that now detract from the reliability of such calculations, especially where heavily prorated wells are involved. Where bottom-hole sampling has been conducted, the full results of these tests should be demanded by the prospective purchaser, before his engineers make a recommendation of value. With such data available, a higher price can with safety be paid for prorated new production than would be justifiable in their absence.

It is not necessary here to make a computation from Coleman's formula to show how the estimate of the original oil is prepared. The equation is complicated and the definitions of the quantities are necessarily long. The formula has been adequately illustrated by several numerical examples in the original presentation.[3] Instead, let us consider how bottom-hole sampling coupled with the gas-solubility data thus obtained may be used to govern operations and to predict investment requirements. Table 1 reproduces a part of Table 3 from Lindsly's report[5] on a bottom-hole sample taken at Crescent, Oklahoma. This sample was taken at an original pressure of 2575 lb. per sq. in. absolute, and the original reservoir pressure was computed to have been 2829 lb. per sq. in. absolute. Let it be assumed that this sample actually had been taken upon completion of the well, and that the computed initial reservoir pressure had been the pressure actually observed. Let it be further assumed that some months after this initial sampling another sample was taken, at which time the observed bottom-hole pressure had dropped to 2575 lb. per sq. in abs. We would expect to find that the gas-solubility data derived from this second sample would closely check with line 2 of Table 1. If they failed to check within reasonable limits, it would indicate that the liberation of gas from solution in reservoir oil does not approximate differential liberation, as has been stated by Lindsly. Assuming that a check was obtained, the probability that a third test, taken at, say, 2144 lb. per sq. in. abs. would agree with line 3 of Table 1, obtained from the first sample, would be tremendously increased. A third test at 2144 lb. per sq. in. abs. would then provide enough points for plotting a "bottom-hole pressure decline

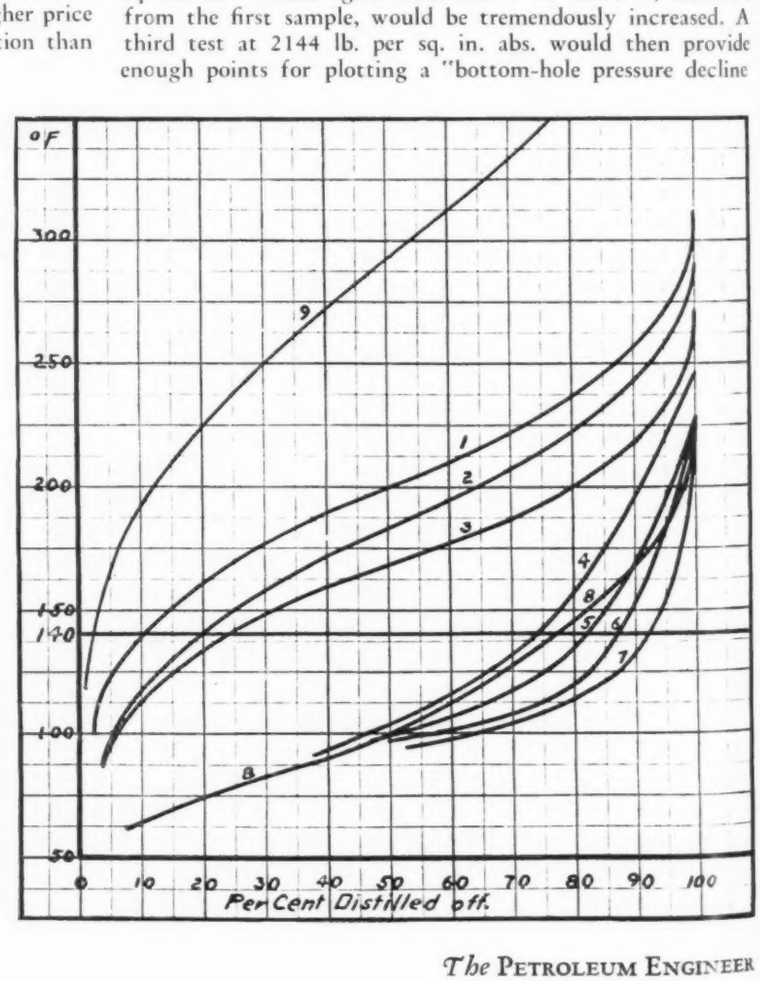


Fig. 1. Engler distillation curves, corrected for loss at lower end

Curve	*Table*	*Line*
1. Actual run of drip gasoline from Glenpool taken from drip 300 feet from vacuum station	5	4
2. Actual run of drip gasoline from Glenpool, taken from drip 1500 feet from vacuum station	5	6
3. Actual run of drip gasoline from Glenpool, taken from drip 1200 feet farther from vacuum station, on same line as yielded curve 1	5	5
4. Constructed from analysis, gasoline from low-pressure separator gas, Oklahoma City	3	9
5. Constructed from analysis, gasoline from separator gas, Crescent well	3	2
6. Constructed from analysis, gasoline from gas differentially liberated from 101 to 14 pounds, Crescent well	3	7
7. Constructed from analysis, gasoline from gas differentially liberated from 283 to 15 pounds, Okla. City, same well as curve 4	3	11
8. Actual run of test-car make. Gas tested 10.65 gal. per min. just after drip gasoline shown in curve 1 came off, and before drip shown in curve 3 came off	5	8
9. Actual run of 56.6 deg. A.P.I. straight-run gasoline made from 38 deg. A.P.I. Oklahoma City crude oil. 91 per cent off at 391 deg. fahr.; end point 423 deg. fahrenheit		

TABLE 2
Conditions of Liberation

Pressure Range	To which was subjected the Oil from which escaped the Gas taken	
	From High-pressure Separator	From Low-pressure Separator
From initial reservoir pressure to bottom-hole pressure	Mixed*	Mixed*
From bottom-hole pressure to well-head pressure, 1103 lb. per sq. in. abs.	Flash	Flash
From 1103 to 265 lb. per sq. in. abs.	Mixed	Mixed
From 265 to 16 lb. per sq. in abs.	.....	Differential

*Large amount of free reservoir gas present, introducing elements of Flash Liberation.

curve," using bottom-hole pressure against time and against total withdrawals to date. Extrapolation of these curves would indicate what reservoir pressure might be expected at any date in the future at the present production rate, or after the withdrawal of any stated amount of oil.

Reference to the analyses of the several samples will indicate the amount and composition of the gas remaining in solution at each pressure interval, the available energy of the solution gas, and the composition of the gas in the gas cap. Adequate data are thus available for controlling the rate of production to effect the most economical recovery, and for forecasting the amount and kind of gas-lift or pumping equipment best suited to the needs of the case, and when it will be needed.

No proper operating program would now contemplate tapping the gas in the gas cap, so that a knowledge of the composition of this gas corresponding to various pressures is of no help in determining the practicability of a gasoline plant at some future date. Unfortunately, the experiments that have been made thus far do not show the composition of the gas released by flash liberation,[4] between pressure P*m* and P*n* after the pressure on the oil has been reduced from the original reservoir pressure to P*m*, the gas in this range having been liberated differentially. However, there are records[2] of two samples of gas from a well at Oklahoma City, one taken from the high-pressure separator and the other from the low-pressure separator. The conditions of liberation are as shown in Table 2.

The well-head pressure was 1103 lb. per sq. in. abs., and a pressure of 265 lb. per sq. in. abs. was held on the high-pressure separator. The oil from this separator discharged into the low-pressure separator, on which a pressure of 16 lb. per sq. in. abs. was held. Initial reservoir and bottom-hole pressures are not shown, but the latter was probably greater than 2000 lb. per sq. inch. Examination of the analyses of these gases reveals that the gas from the high-pressure separator contained substantial amounts of propanes and butanes, but that no pentane or heavier component is shown. The gas from the low-pressure separator contained much less methane and ethane, more butane, and substantial amounts of pentane. No fractions heavier than pentane are shown in the published data, but an adjustment has been made for this apparent inaccuracy, as hereafter described.

For the purpose of investigating the bearing of these experiments upon gasoline-plant installation, I have reconstructed from the analyses of the several gases liberated from solution under different pressure conditions, the types of commercial natural gasoline that could be extracted from each, assuming that all components of the gas heavier than isobutane were completely recovered, and no components lighter than normal butane were recovered. These are shown in Table 3, and the gases from the two separators discussed above are shown on lines 8 and 9. In reconstructing these gasolines it has been assumed that the heaviest component shown in the gas analysis contained also all heavier components up to nonane, in proportion to their vapor pressures at 30 deg. cent.; and that the butane component was composed of iso-butane and normal butane in the proportion of 1:2. Only normal paraffin hydrocarbons were assumed to be present.

Table 3, line 8, shows the probable characteristics of the gasoline extractible from the gas from the low-pressure separator at this Oklahoma City well, assuming that all the N-butane present in the gas was condensed. This is not a commercial product, but by reducing the N-butane content to 25 per cent by weight, a product having the probable characteristics shown in Table 3, line 9, is obtained. An approximation of the Engler distillation curve of such a gasoline is shown in Fig. 1, curve 4. This distillation curve and others prepared from similar analysis data have been constructed by reference to Oberfell's[6] analysis chart for natural gasolines.

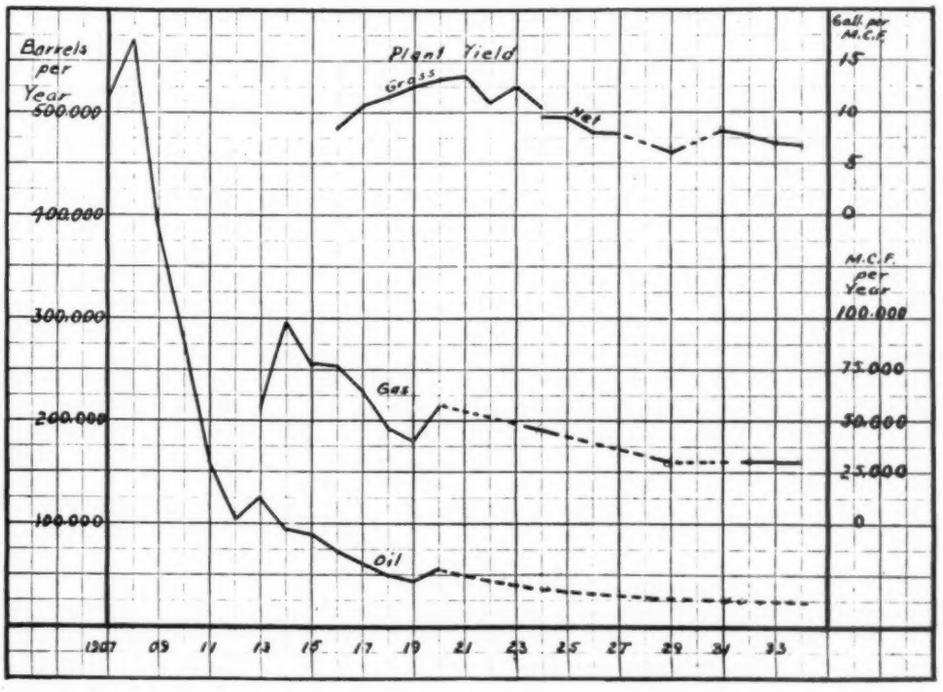


Fig. 2. Partial production history of Glenpool lease, from which drip gasoline samples shown in Table 2 were obtained. Plant yield curve is from gasoline plant running gas from this lease along with other Glenpool gas.

Note increase in plant yield and subsequent decrease, indicating exhaustion of light fractions.

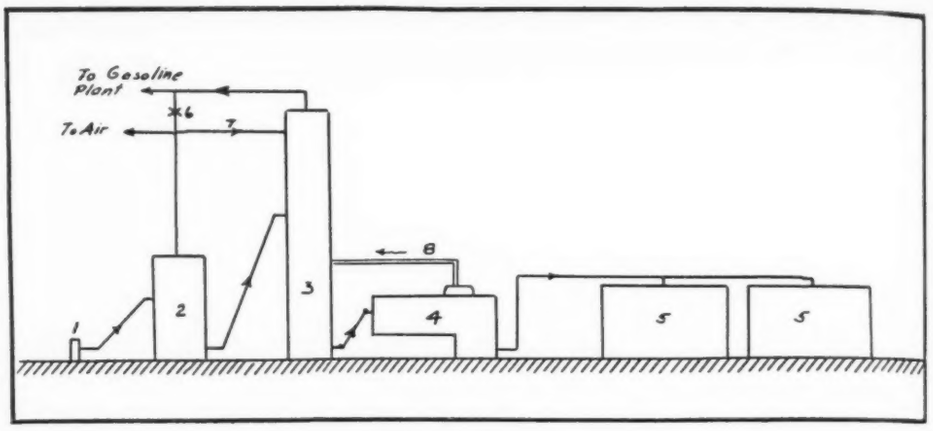


Fig. 3. Suggested modification of double trapping at well, to control gravity of oil in tanks. 1. Well head. 2. High-pressure separator. 3. Bubble-type absorber, for stabilizer. 4. Oil field type boiler for stabilizer kettle. 5. Stock tanks. 6. Gate on by-pass. 7. High-pressure gas line to top of stabilizer. 8. Vapor line from kettle to stabilizer.

Table 3, lines 10 and 11, show the characteristics of the gasoline which might be extracted from the gas from this same well, released by differential liberation between 283 lb. per sq. in. abs., and 15 lb. per sq. in. abs., after the gas had been released by flash liberation between a bottom-hole pressure of 2000 lb. per sq. in., more or less, and a well-head pressure of 1103 lb. per sq in. abs., and differentially from this latter pressure down to 283 lb. per sq. in. abs. The product obtainable from this gas if all the N-butane in the gas is condensed is not a commercial product (line 10), but by reducing the N-butane content to 25 per cent by weight, a commercial product of characteristics shown in line 11 is obtained. An approximate distillation curve for such a gasoline is shown in Fig. 1, curve 7.

It is interesting to note the difference between the gasoline that might be extracted from the low-pressure separator (Table 3, line 9) and that which might be extracted from the gas from the sampling bomb (Table 3, line 11). When flash liberation extended all the way down to 265 lb. per sq. in. abs., the gas escaping from solution between 265 and 16 lb. per sq. in. abs. would produce a commercial gasoline of approximately 24 lb. vapor pressure having 34.1 per cent by liquid volume of hexane and heavier components. When differential liberation prevailed throughout the entire range of pressure drop between well-head pressure and atmosphere, the resulting gasoline having approximately the same vapor pressure would contain only 21.7 per cent by liquid volume of hexane and heavier components. The net yield, in gallons per 1000 cu. ft. of each of these products is about the same: 0.78 gal. per 1000 cu. ft. for the separator gas, and 0.65 gal. for the bomb gas, but differential liberation resulted in retaining in the oil sufficient hexane and heavier material to reduce the percentage of these components in the gasoline from 34.1 to 21.7 per cent.

Table 4 shows the results of analyses of gas from the separator and from the bottom-hole sampling bomb at the well in the Crescent field. The data on the separator gas were furnished by the operator. The data on the bomb gas were taken from Lindsly's[5] paper on these experiments. There was approximately 24 per cent more gas per bbl. of oil escaping from the separator than was released by differential liberation from the bottom-hole sample. Since it is unlikely that any free reservoir gas was escaping from the well, this difference may be in part accounted for by the fact that the gas-oil ratio attributed to the separator gas was determined from field measurements of both gas and oil, which are not as accurate as the careful laboratory measurements to which the bomb sample was subjected. Table 3, lines 1 to 7, set forth the probable characteristics of gasolines extractible from the gas from this well under different conditions of liberation from solution. If all the N-butane in the separator gas is condensed a large quantity of a very wild product is

TABLE 3

Comparison of Computed Properties of Iso-Butane-free Natural Gasoline which might be extracted from gases liberated from solution under various pressure conditions

	Gal. per day	M. Cu. Ft. per day	Gal. per M. Cu. Ft.	Gravity Deg. A.P.I.	Approx. Vapor Press. at 100°F. Lb. per Sq. In.	Percentage by Liquid Volume				
						N-Butane	Pentane	Heavier	Hexane & Per Cent Distilled Off	
									At 100°F	At 140°F
CRESCENT WELL 42.1° A. P. I. OIL										
Separator Gas, Well Head Pres. 950 lb. Separator Pres. 30 lb. per sq. in abs.										
1. Using all N-butane in gas	1,672	466	3.58	98.22	32.54	47.2	31.7	21.1	72	87
2. N-butane reduced to 25 percent wt	834	466	1.79	93.1	24.75	27.0	43.8	29.2	51	82
Gas from bottom-hole sample Liberated above 101 lb. per sq. in. abs.										
3. Using all N-butane in gas	277	342	0.81	107.9	44.13	90.9	7.2	1.9	cannot estimate	
4. N-butane reduced to 25 percent wt	9	342	0.026	95.2	18.96	26.9	57.0	16.1	cannot estimate	
5. Another gasoline	17	342	0.049	100.4	24.93	51.5	37.3	11.2	cannot estimate	
Liberated between 101 lb. per sq. in. abs. and 14 lb. per sq. in. abs.										
6. Using all N-butane in gas	411	50	8.21	98.6	33.30	48.4	33.5	18.1	77	91
7. N-butane reduced to 25 percent wt	196	50	3.91	94.1	24.30	26.8	47.3	25.9	57	87
WELL "D" OKLAHOMA CITY 43° A. P. I. OIL										
Low-Pressure separator gas, 16 lb. per sq. in. abs.										
8 Using all N-butane in gas			2.31	99.3	36.18	56.2	23.2	20.6	cannot estimate	
9. N-butane reduced to 25 percent wt			0.78	93.1	23.72	26.9	38.8	34.1	46	74
Gas from well-head sample, differential liberation 283 to 15 lb. per sq. in. abs.										
10. Using all N-butane in gas			2.44	102.3	38.38	60.7	27.5	11.8	cannot estimate	
11. N-butane reduced to 25 percent. wt			0.65	94.9	24.60	26.8	51.5	21.7	64	92
12. High Pressure separator gas, 265 lb. per sq. in. abs		(1)				contains only traces of pentane and heavier				

(1) Very high gas-oil ratio, possibly as high as 10,000 cu. ft. per barrel, due to pressure of much excess-free reservoir (?) gas.

TABLE 4

Analyses of Gas Released from Solution under different pressure conditions, well at Crescent, Oklahoma

Component	Gas from Separator (1)		Bomb Gas—Differential Liberation (2)						Excess of Separator Gas over Bomb Gas	
			Released		Total	Corrected Cu. Ft. Cu. Ft. per Bbl. to 60° F. per Bbl.				
	Percent by Volume	(3) Cu. Ft. per Bbl. Residual Oil	Above 101 Lb. per Sq. In. Abs.	Between 101 and 14 Lb. per Sq. In. Abs.		Residual Test Oil Conditions	14.65 Lb. per Sq. In. Abs.	Residual Oil	Composition Percent	Gasoline Fraction
O, N, and CO_2	0.0158	17.1	0.0158	0.0000	0.0158	13.86	13.37	3.73	0.0151	
CH_4	0.6850	739.8	0.72763	0.00996	0.73759	646.87	623.84	115.96	0.4704	
C_2H_6	0.0677	73.0	0.06231	0.03852	0.10083	88.43	85.28	(12.28)	.....	
C_3H_8	0.1045	112.9	0.03053	0.03902	0.06955	61.00	58.82	54.08	0.2194	
Iso-Butane	0.0226	24.4	0.01048	0.00812	0.01860	16.31	15.73	8.67	0.0352	
N-Butane	0.0546	59.1	0.02097	0.01625	0.03722	32.64	31.48	27.62	0.1121	0.1121
C_5H_{12}	0.0319	34.5	0.00586	0.00971	0.01557	13.65	13.16	21.34	0.0865	0.0865
C_6H_{14}	0.01251	13.4	0.00030	0.00316	0.00346	3.03	2.92	10.48	0.0425	0.0425
C_7H_{16}	0.00392	4.2	0.00005	0.00098	0.00103	0.90	0.87	3.33	0.0135	0.0135
C_8H_{18}	0.00124	1.3	0.00001	0.00031	0.00032	0.28	0.27	1.03	0.0042	0.0042
C_9H_{20}	0.00033	0.3	.....	0.00003	0.00003	0.03	0.03	0.27	0.0011	0.0011
Totals	1.0000	1080.0 (3)	0.87394	0.12606	1.00000	877.00	845.77	246.51	1.0000	0.2599

1. Operator's records, measured at 60° F. and 14.65 lb. per sq. in. abs. Hexane and heavier component assumed to contain compounds in proportion to their vapor pressure at 30°C.
2. Lindsly, Ben E., Experimental Results from a Bottom-hole Sample, Crescent Pool, Oklahoma, measured at 70 F. and 14.4 lb. per sq. in. abs. Hexane and heavier component broken down as above.
3. Operator reports gas-oil ratio as 1080 cu. ft. per barrel based on tests prior and subsequent to experiment. Lindsly records approximately 900 to 1000 cu. ft. per barrel. Gas from separator shows 28 per cent more volume than gas released from solution by differential liberation on basis of operator's records; 18 per cent more on basis of Lindsly's records. Of excess of separator gas over bomb gas, 25.99 per cent is N-Butane and heavier.

obtained (Table 3, line 1). If the N-butane content of this gasoline is reduced to 25 per cent by weight, a commercial product (Table 3, line 2) is obtained, having 29.2 per cent by liquid volume of hexane and heavier components. When differential liberation is applied throughout the entire pressure range, the gas liberated between 101 and 14 lb. per sq. in. abs. yields a commercial gasoline having 25.9 per cent by liquid volume of hexane and heavier; but the quantity of this gasoline is less than one-quarter of that obtained from the separator gas. Thus differential liberation throughout the entire range from bottom-hole pressure to atmosphere has resulted in retaining in the oil 69 per cent of the hexane and heavier components which were removed from solution in the oil by flash liberation of the gas. Approximate distillation curves of these two gasolines are shown in Fig. 1, curves 5 and 6. The gas released by differential liberation above 101 lb. per sq. in. abs. yielded only traces of any kind of gasoline (Table 3, lines 3, 4 and 5).

Mills and Heithecker[2] have shown that the gravity of crude oil can be substantially increased by increasing the amount of gas dissolved in it; and Lindsly has found that differential liberation of gas over a wide pressure range, by retaining in solution more of the lighter liquids while the fixed gases are removed, results in raising the gravity of the residual oil—that is, the oil in tanks—by from one to three deg. A.P.I. Whereas it is not possible in practice to subject bottom-hole oil to differential liberation throughout the entire pressure drop, it is possible to approximate these conditions by multiple trapping. Thus, two separators can be installed at a well, which produces under single trapping, oil having a gravity of, say, 38 deg. A.P.I. If the pressure on the high-pressure separator is carried at about 200 lb. and that on the low-pressure separator at about 10 lb., very little, if any, of the pentanes and heavier components of the gas-oil mixture will escape in the gas discharged from the high-pressure separator. See Table 3, lines 3, 4 and 5. The result is that more of them will be left in solution when the oil is discharged from the low-pressure separator. Such a procedure might readily raise the gravity of the oil more than one deg. A.P.I., and mean considerable additional revenue to the property. However, if the gravity of the oil under single trapping is already above 40 deg. A.P.I., there is no advantage in retaining still more of the lighter components in solution. It would be better to weather off the crude to a minimum gravity of 40 deg. A.P.I. and sell the vapors thus produced to a gasoline plant, thus gaining revenue from the part of the original crude for which no premium is paid under present schedules.

An adaptation of multiple trapping is suggested in Fig. 3, in which an old bubble-type absorber is shown substituted for the low-pressure separator. The oil from the high-pressure separator is discharged into the inlet port of the absorber, into the top of which some of the gas from the high-pressure separator is expanded to furnish refrigeration. An old oil-field-type boiler forms the kettle for this stabilizer, and permits the oil to be heated if necessary. Enough pressure is assumed to be held on the absorber to throw the stabilized oil into the stock tanks. The remainder of the high-pressure gas is disposed of without further treatment, and the gas from the top of the absorber is delivered to the gasoline plant for treatment. This arrangement would cost very little, since nearly all companies have idle absorption equipment and old boilers on hand; and it would result in the delivery to the pipe line of a crude oil from which all of the permanent gases had been removed. The vapors thus made available for gasoline extraction will contain a much greater percentage of hexane and heavier components than where ordinary double trapping is in practice. Such vapors, sold to an outside gasoline plant, would command a higher royalty rate than could otherwise be obtained; and it is probable that even the gas from the low-pressure separator, where two are used, would command a higher rate of royalty than well-pressure gas. Thus even the operator who has not sufficient production in a field to warrant the installation of his own gasoline plant can derive some benefit from the reduced investment necessary on the part of the owner of the gasoline plant.

One of the most regrettable sources of waste in the early development of a property is the enormous volume of gas that is often vented to the air without treatment, while the management is trying to decide how large a gasoline plant to install, or whether or not to install one at all. Often from one to three years is required to reach this decision. There is always a great risk in building a gasoline plant in a new field, in that, if it is built to handle all the gas available in the flush period of production, a large part of this investment will be idle after this period has passed. A system of multiple trapping, or the stabilizing adaptation here suggested, would solve this dilemma. Small gasoline extraction equipment could be installed very early in the life of the field, designed to treat only the gas discharged from the low-pressure separators. As conditions changed with declin-

ing production and gas volumes, and it became no longer feasible to continue double trapping, all the gas could then be turned through the plant. By this time, however, the total volume of gas would probably not be greater than could easily be handled with the plant already in place, so that all of the investment in gasoline-extraction equipment could be kept active throughout the entire period of its existence; and all the gasoline that now is wasted to the air from new properties could be saved without risk of overbuilding the gasoline plant.

Royalty owners, lease operators and gasoline manufacturers would thus benefit directly and largely. It is a curious fact that the large quantities of gasoline that are allowed to escape during the early life of a field are viewed with so little concern, whereas very substantial sums are continually being expended in improving plant recovery efficiency to effect an increase in recovery negligible in comparison.

A much greater reduction in gasoline recovery facilities is possible than is indicated by the consideration of gas volumes alone. In absorber design provision has to be made for absorbing all the propanes and iso-butane from a mixture very rich in methane and ethane. The low-pressure separator gas contains relatively small amounts of methane and ethane, so that the propanes and the iso-butane are in higher concentration. Oil circulation, still and dephlegmator capacity and cooling capacity can therefore be still further reduced.

Another possibility that is suggested by the arrangement shown in Fig. 3, which would be practicable as long as there was a considerable volume of gas being discharged from the high-pressure separator, is the use of this gas to drive a compressor operating upon the gas from the low-pressure separator or the crude stabilizer. The high percentage of propanes and iso-butane in the low-pressure gas would make this peculiarly suited to vapor-phase stabilization. The expansion of the surplus high-pressure gas would provide refrigeration for knocking back the propanes for reflux purposes, and the heat of compression of the low-pressure gas would probably supply all the heat needed to operate the system. A gasoline plant of this nature could be installed at very small cost, as soon as sufficient gas became available to run one unit; and would represent a still further reduction in gasoline recovery equipment below the present conventional minimum.

In further illustration of the points raised by these solubility investigations, there are submitted some data dealing with a lease in the Glenpool, in Creek County, Oklahoma. Fig. 2 gives a partial production history of this property. It is a lease of 160 acres in the central part of the field, and was fully developed prior to 1910. Vacuum was applied in 1913, and in 1928-29 approximately 26 in. of vacuum had been held on the wells for upward of 12 years. Production conditions have been practically uniform throughout the whole field for many years. The "plant yield" curve shown on Fig. 2 is the yield of the gasoline plant in the field, which took the gas from this lease along with about 20 times as much more gas from other near-by leases.

The most interesting point developed from Fig. 2 is the shape of the "plant yield" curve. The gas from this field increased in richness for several years after vacuum was applied, and then rapidly declined from a peak of about 13 gal. per 1000 cu. ft. to a present rate of a little over 6 gal. per 1000 cu. ft. In the light of the recent studies under discussion, this condition would indicate:

1. The exhaustion of the original gas in the gas cap above the oil. This gas was released from solution differentially, and contained relatively large amounts of methane and ethane. As it was withdrawn from the gas cap, subsequent increments contained greater and greater proportions of the heavier components.
2. The removal from the reservoir oil of a large amount of the lighter fractions, which would have remained in solution at the reservoir temperature had not vacuum been applied.
3. The exhaustion from all the remaining oil of practically all of the permanent gases, so that the proportion of the heavier components which these gases will carry away from a heavy oil mixture is severely reduced.

During the period of declining plant yield in this field there was observed a growing disparity between the theoretical gallons indicated by the sum of the products of the test yields at the various meters by the corresponding gas volumes, and the theoretical gallons indicated by tests at the plant master meter. The field tests were always in excess of the master meter test, and this difference was not compensated for by the collections of drip gasoline. This condition led to the study in which the drip gasoline data offered in Table 5 were collected.

In Fig. 1, curves 1, 2 and 3 show actual Engler distillations of three samples of drip gasoline collected on one day from three drips on the Glenpool lease referred to above. Curve 8 is a distillation of the test-car make from gas from the "A" wells. Approximate analyses of these gasolines, inferred by reference to Oberfell's analysis chart, are shown

TABLE 5

Distillation Characteristics and Inferred Analyses of some Drip Gasolines from a property in Glenpool, Oklahoma, with some data on gas in that field

Line	Gal. per Day (1)	M. Cu. Ft. per Day (1)	Gal. per M. Cu. Ft. (1)	Gravity Deg. API (2)	Percentage by Liquid Volume: Butanes: Pentane Lighter (4)	Butanes: Hexane and Heavier (4)	Hexane and Heavier (4)	Percentage Distilled Off: At 100° F. (2)	At 140° F. (2)	End Point Deg. F. (2)
Gas going to gasoline plant from lease										
1. Group "A" wells	552	53.4	10.33							
2. Group "B" wells	408	46.7	8.73							
3. Total	960	100.1	9.59							
Drip gasoline	(3)									
4. From "A" wells caught 300 ft. from vacuum station	56			66.3	cannot estimate from chart			0	11.0	313
5. caught 1500 ft. from vacuum station	107			70.8	9.0	17.7	73.3	6	24.5	292
From "B" wells										
6. caught 1500 ft. from vacuum station	219			70.4	11.0	16.9	72.1	6.5	20.0	272
Total drip gasoline	382									
7. Total gasoline from lease	1,342									
8. Test-car make, gas from "A" wells tested 310 ft. from vacuum station			10.65	87.0	28.5	39.0	32.5	50.0	77.5	236

Initial gravities of oil in Glenpool, 38° to 39° Be. Gravities in November, 1927, 33° to 35° A. P. I.
This lease yielded 11,900 gallons of drip gasoline in the month of November, 1927.

Notes (1)—Plant records, field measurements of gas, and actual settlement test of gas.
(2)—Special distillation tests of drip gasoline, January, 1928.
(3)—Special gauges of drip gasoline from this lease, November, 1927. Drip condensed at 45° F. and 10 in. of vacuum from gas drawn from wells at 26 in. vacuum.
(4)—Inferred analyses using Oberfell's analysis chart for natural gasolines.

in Table 5, lines 4, 5, 6 and 8. This gas was tested at a point about 300 ft. from the vacuum station, and about 10 ft. downstream from the drip wherein was collected the drip gasoline shown in Fig. 1, curve 1. The test at this point was 10.65 gal. per 1000 cu. ft. About 1200 ft. farther downstream from the test point, was located the drip from which the sample shown in Fig. 1, curve 3, was collected. The upstream sample was too heavy to have its characteristics included within the limits of the analysis chart for natural gasolines. The downstream sample was just light enough to fall on the chart, and an approximate analysis is given in Table 5, line 5. The drip gasoline shown in Fig. 1, curve 2, Table 5, line 6, was obtained from a drip located about 1500 ft. from the vacuum station serving the "B" wells on this same property.

These analyses and distillation curves show the kind of material that is being pulled out of the Glenpool crude as a result of the long-continued application of high vacuum. The gravity of the crude from this field has dropped from about 38 deg. A.P.I. in the early life of the field to between 33 and 34 deg. A.P.I. at present. These samples of drip gasoline condensed in the line at 10 in. of vacuum and at 45 deg. fahrenheit. The value of this liquid to the operator is greater as crude oil than it is as natural gasoline. This condition has prevailed for several years, and bids fair to continue. Were the Glenpool being developed in 1934, instead of having been developed in 1908, it is hardly likely that an investigator in 1960 would find that the drip gasoline that was then condensing in the lines would have an initial boiling point of 100 deg. fahr. and over.

A comparison of the inferred analyses[6] of this drip gasoline produced by wells long subjected to high vacuum Table 5, with the analyses of the reconstructed gasolines made from gas from wells still under high natural pressure, Table 3, shows the very high percentage of hexane and heavier fractions, 73 per cent in the drip gasolines as compared to 29 to 34 per cent in the others. The distillation curves of these two groups of products form two distinct groups on Fig. 1. It is interesting to note that the test-car make, Fig. 1, curve 8, from Glenpool gas displays a distillation curve closely agreeing with the curves of the lighter group. The wide spread between the distillation curves of these two groups bears out the findings of the recent studies, pointing to the selective solubility.

There is still much work to be done along these lines, which may be counted upon to be well worth its cost in money and effort; and it is hoped that this paper will suggest some new points for future investigation, as well as fulfill its patent purpose of pointing out the advantages already accrued.

REFERENCES

1. B. B. Dow and C. E. Reistle, Jr.: "Absorption of Natural Gas and Air in Crude Petroleum. *Minerals and Metals* (May, 1924), 336.
   C. E. Beecher and I. P. Parkhurst: "Effect of Dissolved Gas Upon the Viscosity and Surface Tension of Crude Oil." Trans. A.I.M.E., Petr. Dev. and Tech. (1927), 51.
   B. B. Dow and L. P. Calkins: "Solubility and Effects of Natural Gas and Air in Crude Oil." U. S. Bureau of Mines, *Report of Investigation*, 2732.
   R. van A. Mills and R. E. Heithecker: "Volumetric and A.P.I. Gravity Changes Due to the Solution of Gas in Crude Oil," U. S. Bureau of Mines, *Report of Investigation*, 2893.
   W. N. Lacey: "Experiments on the Rate of Solution of Gas in Oil." Inst. Petr. Tech. (August, 1931).
2. B. E. Lindsly: "Solubility and Liberation of Gas from Natural Oil-Gas Solutions." U. S. Bureau of Mines, *Technical Paper*, 554.
3. S. Coleman, H. D. Wilde, Jr., and T. V. Moore: "Quantitative Effect of Gas-Oil Ratio on Decline of Average Rock Pressure." *Trans.*, A.I.M.E., Petr. Dev. and Tech. (1930).
4. B. E. Lindsly: Note 3 supra, 4.
5. B. E. Lindsly: "Experiments on a Bottom-hole Sample at Crescent, Oklahoma." In course of publication.
6. G. G. Oberfell: "Analysis Chart for Natural Gasolines." Refinery Supply Company, Tulsa.

Simple Pipe Arrangement for Utilizing Exhaust Steam

By W. F. SCHAPHORST

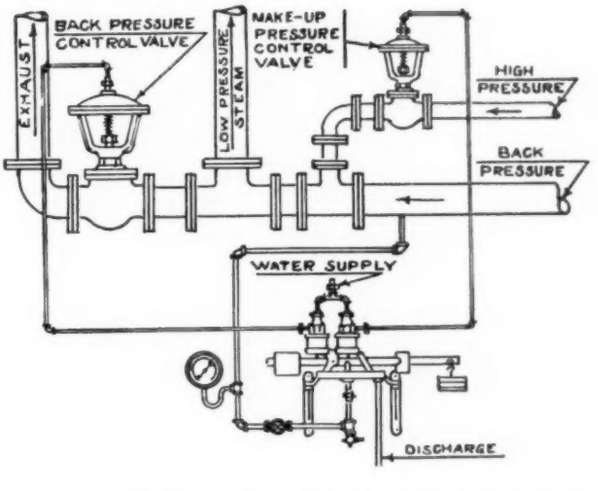
"How can we rearrange our piping in order to utilize our exhaust steam for heating or processing?" is a common question. I have never seen or heard an answer that didn't tend to befuddle the mind of the questioner. So, here is my effort:

The sketch herewith shows one of the simplest and best hook-ups from every standpoint.

This arrangement makes it possible to utilize 100 per cent of the exhaust provided such usage is at all possible. Should there be a surplus of exhaust steam at any time it is automatically switched by the regulator into the atmosphere. If on the other hand the amount of exhaust steam is insufficient for requirements, the sensitive control device automatically admits live steam make-up into the exhaust. Then, as soon as the required amount of extra heat is supplied the live steam is again automatically cut off.

In other words, this arrangement guards the exhaust and saves live steam with the utmost precision—much more efficiently and economically than would be possible with the best of human supervision and hand control.

An important advantage is that this arrangement usually



permits the utilization of much of the old piping and valves. That is, it is not necessary to install entirely new equipment throughout in attaining the highest degree of modernization.

Refinery Economics

Article 2. Realizations of Oil Stocks

By W. L. NELSON
Consultant*

THE importance of knowing the precise amount of each of the many products that may be produced from a crude oil is seldom realized by refiners. Most refiners are content with the production of the same products that they have been producing for years unless some drastic change in market conditions becomes apparent. The smaller changes that continuously occur in the market price of products are often overlooked and no indication of these changes appears until the profits for the year are computed. During the last five years refiners have bemoaned the low market value of refined products and the small profit (sometimes a loss) that is earned by refinery operation. This condition first received general attention during the depression years but probably little relief will be felt with the return of prosperity. The petroleum industry, particularly in the refinery, has graduated from the youthful stage during which the margin of profit was large and any refiner could expect to make a profit. Today petroleum refining is a highly competitive business and those refiners who do not take advantage of every opportunity for improvement, will fail. I believe the era of easy profits is gone forever.

Yet the economics of refining is not a simple problem. Many factors cannot be discussed unless a definite situation presents itself. Much depends upon the marketing facilities that a refiner has developed. As an example, solvents are sometimes sold for eight or nine cents at the refinery, but not all refiners can sell solvents because the demand is relatively small. Likewise, treated cylinder stock is quoted on market pages but only a few buyers purchase cylinder stock in large quantities. Further, neutral oils, etc., are quoted on the market but the bulk of such oil is blended in the refinery, and is never sold to jobbers. In this case the market prices of neutral oil and bright stock are of little significance because the price that is paid for blended motor oil at the outlet station, governs the profit of the refiner. In fact, most companies now control filling stations, etc., as outlets and they are only interested in the total margin between the crude oil and the station price.

Nevertheless, the evaluation and realization of oil stocks find many uses and the purpose of this paper is to draw some general comparisons of the value of oil stocks and of different methods of processing. An evaluation of the yields of the various products that can be produced is necessary but the subject of laboratory evaluation is beyond the scope of this paper.

One of the obvious uses for realizations is in the development of new processes. No other method of studying the economics of a newly developed process, is available.

Refinery Prices

The market prices that are shown in Table I will be used as a basis in the realizations that follow. Most prices are lower than they were in 1928 and a little lower than a year ago. However, the price of neutrals has increased greatly and in Pennsylvania the neutrals are worth more than bright stock. Even in the Mid-Continent area, the price of 400-vis. neutral is the same as for 150-vis. bright stock. This increase is due to a more widespread use of light and medium motor oils. In the Mid-Continent area, this demand can be partly met by processing more crude oil for lubricants and by cracking the cylinder stock or fuel oil. But in the Pennsylvanian district no such alternate is available because additional crude oil is not available. At the present time a new process is being developed for the production of neutrals.[1]

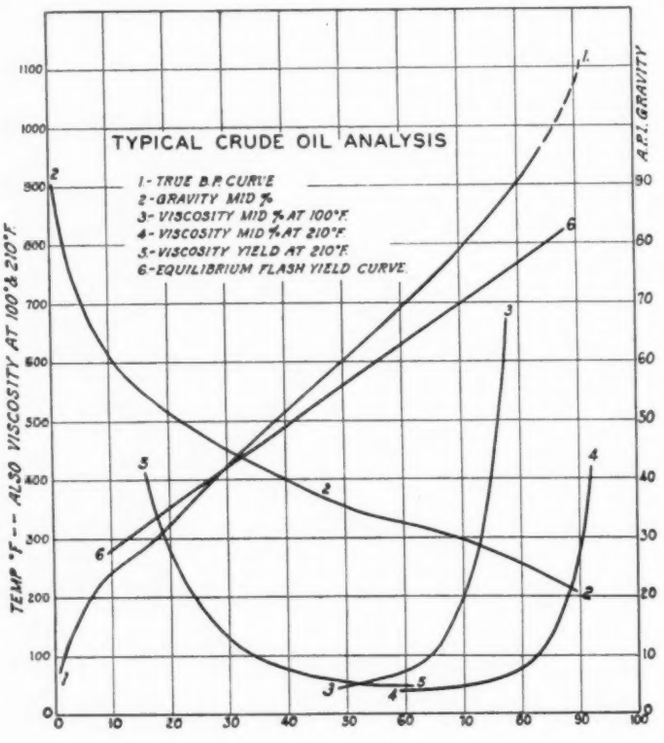

TYPICAL CRUDE OIL ANALYSIS
1-TRUE B.P. CURVE
2-GRAVITY MID %
3-VISCOSITY MID % AT 100°F.
4-VISCOSITY MID % AT 210°F.
5-VISCOSITY YIELD AT 210°F.
6-EQUILIBRIUM FLASH YIELD CURVE
TEMP °F -- AL30 VISCOSITY AT 100° & 210°F.
A.P.I. GRAVITY

Fig. 1—37.3 A.P.I. mixed base crude oil

Other materials that do not follow the general downward trend of prices are Furnace Oil and Gas Oil. The prices today are nearly the same as in 1928. Perhaps this is due to the increasing demand for distilled Diesel fuels. Diesel engines are being more and more widely used for trucks, busses, locomotives, and motor boats. Doubtless the demand for distillate fuels will increase further and perhaps reach a value only a little lower than that of gasoline.

In the realizations that follow, the operating costs that were presented in the

*Professor of Petroleum Refining, University of Tulsa.

[1]By this process, cylinder stock can be decomposed into neutral oil of any viscosity without destroying the inherent properties of Pa. oil. At the same time the cost of dewaxing is decreased because centrifuging is avoided. The claims of this process have been recently allowed at the patent office.

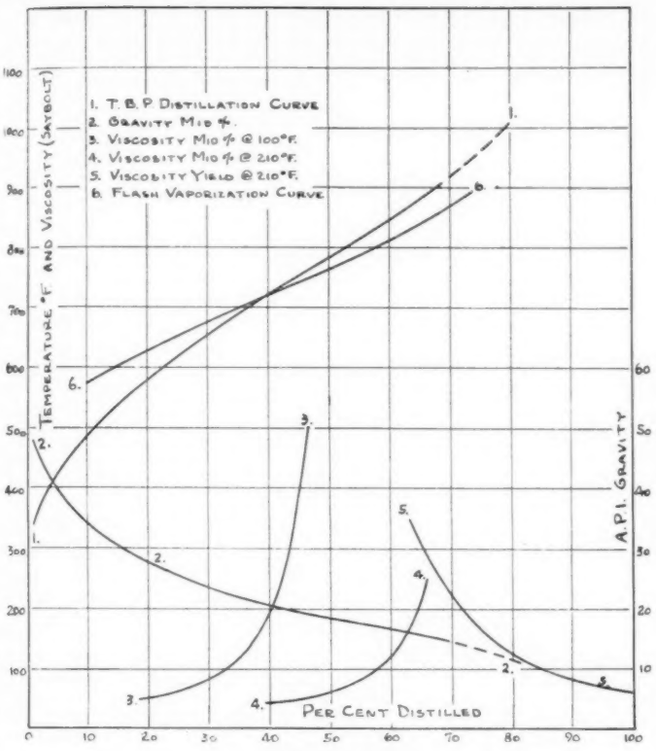

1. T.B.P Distillation Curve
2. Gravity Mid %
3. Viscosity Mid % @ 100°F.
4. Viscosity Mid % @ 210°F.
5. Viscosity Yield @ 210°F.
6. Flash Vaporization Curve
Temperature °F and Viscosity (Saybolt)
A.P.I. Gravity
Per Cent Distilled

Fig. 2—42.2 A.P.I. paraffin base crude oil

October number of the *Petroleum Engineer*[2] will be used.

Value of Products from Crude Oil

The products that may be produced from a 37.3 mixed base crude oil and the value of the products at the plant, are shown in Table II. The prices are for Oklahoma. An evaluation analysis of the oil is shown in Fig. 1.

The prices of crude oil were:

July, 1928	$1.34
September, 1934	1.02

An inspection of Table II reveals that Topping, or Topping and Cracking, are not profitable operations today. More complete cost data are given in Table V.

Similar data for a 42.2-deg. gravity A.P.I. Paraffin Base Crude Oil are shown in Fig. 2 and Table III. The price of such a crude was about 2.20 per bbl. in September,1934.

Data for a 20.2-deg. gravity A.P.I. naphthene base crude oil are shown in Fig. 3 and Table IV. The price of such a crude oil would be about $0.90 per barrel.

Realizations of Crude Oils

The profit that can be expected by processing for the products as outlined heretofore, is an elusive figure. It depends upon factors that can only be estimated by a complete knowledge of the policies of the management of the company and

[2]Nelson—"Refinery Economics I" *The Petroleum Engineer*, Oct. (1934).

TABLE I

Market Prices—Cents Per Gallon

Material	July 3, 1928 Okla.	Oct. 17, 1933 Okla.	September 6, 1934 Okla.	Penn.	Gulf Coast or Texas
Gasoline U. S. Motor—Regular	7.945	4.75	4.	5.62	3.87
Gasoline 60-62 400 E. P. Prem		5.37	4.62	6.87	4.5
Naphtha 50-52 450 E. P. Blend	7.62	4.25		5.5	.....
Stoddard Solvent 300-410		6.12	6.5		
Lacquer Diluent 140-200		8.75	9.		
Kerosene 41-43	4.75	3.5	3.25		4.62
Kerosene 42-44	5.	3.62	3.37	4.5[1]	
Furnace Oil 32-36 Straw	2.62	2.87	2.62		
Furnace Oil 38-41 Prime		3.	2.75	3.75	
Gas Oil—Cracking Stock	2.5	1.87	2.		3.75
Gas Oil 32-36 0-15 Cold Test		2.25	2.75		
Fuel Oil 20-22	1.5	1.3	1.73		
Fuel Oil below 16		1.2	1.54		2.5
Neutral Oils 0-10 Cold Test					
150 Vis.—3 color	8.5*	7.25	10.	22.5†	
200 Vis.—3 color	10.5*	9.	11.75	29. †	7.5
280 Vis.—3 color	16. *	12.	14.75		8.
400 Vis.—4 color	18. est.	14.75	17.25		9.
1200 Vis.—3½ color					10.
S. R. Cylinder Stock—600-light green	8.	6.25	7.	13.	
Bright Stock					
190 Vis.—D	29.	24.	20		
150-160 Vis.—D 0-10 cold test	22.	21.25	17.	22	
White Crude Scale 124-126	4.	3.5	3.37	3	

*Higher cold test. †Vis. at 70 deg. fahr. [1]45 Gr.

TABLE II

Products from Mixed Base Oil (37.3 A.P.I.)

Material	Per Cent		Value of Products at Refinery $ per bbl. of crude oil	
	Untreated	Finished	Sept. 1934	July 1928
Topping				
Gasoline U. S. Motor Reg	34.	33.	.554	1.11
Kerosene 41-43	4.5	4.5	.061	.088
Gas Oil—Cr. Stock	34.	34.	.286	.322[1]
Fuel Oil 20-22	26.	26.	.189	.164
Loss (Assumed)	1.5	2.5		
			$1.090	$1.684
Topping and Cracking				
Gasoline 400—Premium	57.*	55.	1.068	2.02[1]
Kerosene St. Run—42-44	13.	12.5	.177	.262
Furnace Oil 39-41 straw	4.	4.	.044	.05[1]
Fuel Oil 8-9	18.	18.	.116	.098[1]
Loss and Gas	8.	10.5		
			$1.405	$2.43
Complete Processing (Vacuum Distillation)				
Gasoline—400-Reg	28.	27.5	.465	.939
Kerosene 42-44	13.	12.5	.177	.262
Gas Oil 32-36 0-10 C. T	22.	22.	.254	.243[1]
Neutral 150 Vis	5.	5.	.21	.178
Neutral 400 Vis	10.	9.	.652	.68
Bright Stock 190-200 Vis	16.6	13.3	1.12	1.62
Vacuum Tar	4.0	4.0		
Loss, Sludge, Wax, etc	1.4	6.7		
			$2.878	$3.922
Solvent Manufacture and Cracking				
Gasoline—400—Premium†	34.8	33.0	.655	
Lacquer Diluent or Rubber Solvent	5.5	5.0	.189	
Cleaners or V. M. & P. Naphtha	20.5	21.5	.591	
Kerosene 42-44	13.0	12.5	.177	
Fuel Oil—Cracked	20.7	20.7	.134	
Loss, etc	5.5	7.3		
			$1.746	

*Nelson—"Cracking II", The Petroleum Engineer, August, 1933.
†No Straight-Run Gasoline except Natural Gasoline. [1]Estimated.

TABLE III

Products from Paraffin Base Oil (42.2 deg. gravity A.P.I.)

Material	Per Cent		Value of Products at Refinery $ per bbl. of crude oil September, 1934
	Untreated	Finished	
Lubricating Oil Processing I (residuum)			
Gasoline—400-Reg	33.	32.	.755
Kerosene 45	10.	9.5	18
Furnace Oil 38-41	23.8	23.8	.375
Neutral 200 Vis. at 70 / 105 Vis. at 100	22.2	21.6	2.62
Bright Stock 200 Vis	9.7	9.1	.955 (est.)
Loss, etc	1.3	4.0	
			$4.885
Lubricating Oil Processing II (residuum)			
Gasoline—400-Reg	33.	32.	.755
Kerosene 45	10.	9.5	18
Furnace Oil	17.7	17.7	279
Neutral 150 Vis. at 70 / 85 Vis. at 100	26.3	25.4	2.40
Bright Stock 150 Vis	11.6	11.1	1.022
Loss, etc	1.4	4.3	
			$4.636

TABLE IV

Products from Gulf Coast Oil (20.2 deg. gravity A.P.I.)

Material	Per Cent		Value of Products at Refinery $ per bbl. of crude oil September, 1934
	Untreated	Finished	
Topping and Cracking			
Gasoline—400-Premium	39.5	38.	.72
Kerosene 41-43	7.	6.	.106
Furnace Oil 32-36 Straw	7.	7.	.073 (est.)
Fuel Oil Cracked	41.6	41.6	.394 (est.)
Loss and Gas	4.9	7.4	
			$1.293
Complete Processing (Cracking and Vacuum distillation)			
Gasoline—400-Premium	19.1	18.6	.35
Fuel Oil Cracked	9.4	9.4	.089
Neutral 1200 Vis. at 100	42.	38.2	1.605
Asphalt (100 Pene.)*	25.	25.0	.525
Loss, Sludge, Gas, etc	4.5	8.8	
			$2.569

*Estimated value—5 cents/gallon.

its business structure. Some companies maintain a large sales staff or spend much money on advertising. Some must pay large crude freight charges and sometimes the freight charges on refined products are large. Some companies depreciate their equipment rapidly but others carry the old equipment on the books for many years. Some companies pay enormous salaries to the management. Finally, the cost of operation[2] varies widely from plant to plant and is a function of management and equipment.

These many factors make the estimation of the profit, difficult. Table V shows the gross profit, which must care for executive management, taxes, freight or pipeline charges, sales, and laboratory development. The items that are subtracted from the value of the products are the cost of (1) Crude oil, (2) Direct operating expenses, and (3) Depreciation in six years for new distillation and cracking equipment for a 3000-bbl. plant. It is assumed that the refinery is already in operation so that storage, laboratory, treating, dewaxing, loading facilities etc., are available. The value of products was taken directly from Tables II, III and IV.

Study of Unit Costs in Refining

Inefficiency in refinery operation can only be remedied by a detailed examination. The first step in such an examination is to conduct a comprehensive laboratory study to determine if the plant operations are successfully recovering the maximum amount of each of the most valuable products. More than a routine laboratory examination is necessary. Surprising results are often obtained even in well operated plants. Managers are prone to overlook such losses in yield because the same loss has been occurring for years.

The overall costs of processing, as given in the October article[2] of *The Petroleum Engineer*, tell little of the efficiency

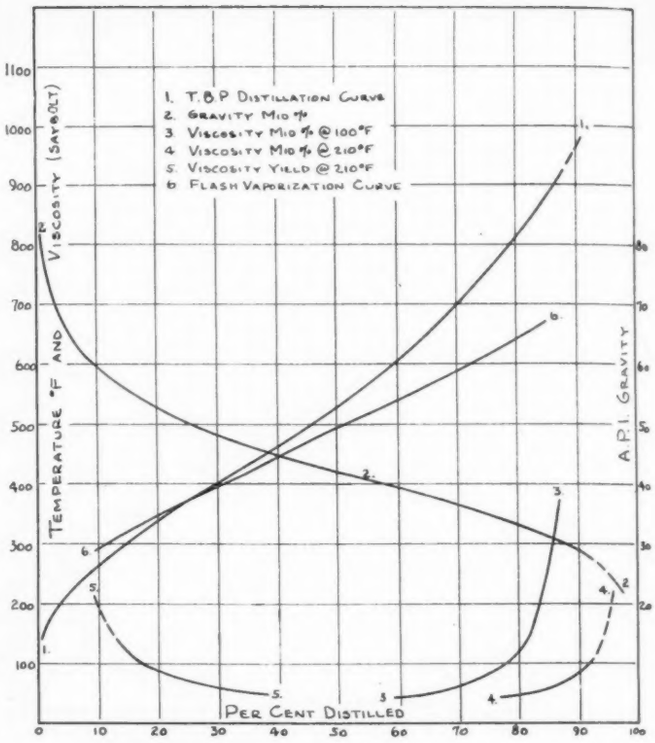

1. T.B.P Distillation Curve
2. Gravity Mid %
3. Viscosity Mid % @ 100°F
4. Viscosity Mid % @ 210°F
5. Viscosity Yield @ 210°F
6. Flash Vaporization Curve
Temperature °F and Viscosity (Saybolt)
A.P.I. Gravity
Per Cent Distilled

Fig. 3—20.2 A.P.I. naphthene base crude oil

of plant operation. Even if the cost of operation is low compared to the figures that were given, the cost may still be higher than it should be. The only way to reveal undue cost is to study each item of cost or equipment separately. The cost of producing steam or the cost of generating heat in a pipestill are examples of items that will usually bear separate attention. As an example, the cost of steam per bbl. of crude oil is usually less than four cents. The boiler plant may be grossly inefficient and yet the cost per bbl. may be high by only half a cent. An improvement in the efficiency could easily be made and a half cent per bbl. for a plant of 3000 bbl. per day amounts to almost $5000 per year. Thus, a half cent is lost in the total processing cost but it is glaringly apparent if the boiler plant is studied separately. For a 3000-bbl. plant each cent in the per-barrel operating cost that can be saved, amounts to almost $10,000.00 per year. Many companies call in a consultant at yearly intervals and larger companies keep a man for the express purpose of accumulating unit costs.

Several of the unit costs of processing will be studied in the third article of this series, which will appear in the December issue.

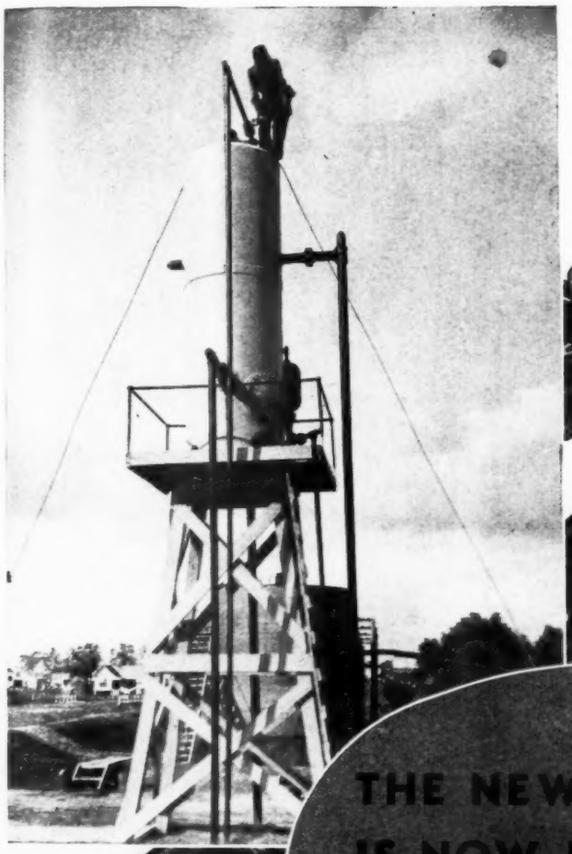
TABLE V

Gross Profits—Dollars Per Barrel of Crude Oil

Locality	Type of Operation	Date	Value of Products	Expenses			Total Costs	Gross Profit
				Crude Oil	Operation	Depreciation		
Mid Cont	Topping	July, 1928	1.684	1.34	.18	.02	1.54	.144
Mid Cont	Top. & Crack.	July, 1928	2.43	1.34	.35	.06	1.75	.68
Mid Cont	Complete	July, 1928	3.922	1.50*	.40	.05	1.95	1.972
Mid Cont	Topping	Sept., 1934	1.09	1.02	.16	.02	1.20	.....
Mid Cont	Top. & Crack.	Sept., 1934	1.405	1.02	.33	.06	1.41	.....
Mid Cont	Complete	Sept., 1934	2.878	1.12*	.38	.05	1.55	1.328
Mid Cont	Solvent	Sept., 1934	1.746	1.02	.35	.06	1.43	.316
Penn	Lub. Oil I	Sept., 1934	4.885	2.20	.42	.03	2.65	2.235
Penn	Lub. Oil II	Sept., 1934	4.636	2.20	.40	.03	2.63	2.006
Gulf Coast	Top. & Crack.	Sept., 1934	1.293	.90	.35	.07	1.32	.....
Gulf Coast	Complete	Sept., 1934	2.569	1.00*	.44	.07	1.51	1.059

*Special price for premium crude oil.

NO MORE NEED TO GAMBLE
ON PIPE WRENCH STRENGTH



New TRIMO ALLOY PIPE WRENCH
MADE ENTIRELY OF HEAT TREATED CHROME-MOLYBDENUM MANGANESE & NICKEL STEEL ALLOYS

Look for the red tag wired to the handle.

THE NEW TRIMO ALLOY IS NOW MADE OF CHROME MOLYBDENUM, MANGANESE AND NICKEL ALLOY STEEL!

It has always been a matter of record in the oil industry that it paid to use the strongest, safest pipe wrenches obtainable. Even with the best, breakage was costly in dollars and in human safety.

Now comes a new standard of safety and strength —the pipe wrench which you must use for maximum safety and strength — the new TRIMO-ALLOY stronger than anything ever offered in the wrench market because it is made of heat treated alloy steel throughout.

Your supply house now has the new ALLOY WRENCH; for a small outlay you can modernize your wrench equipment.

THE NEW TRIMO-ALLOY PIPE WRENCH
112% STRONGER
AS A RESULT OF CHROME MOLY CONSTRUCTION

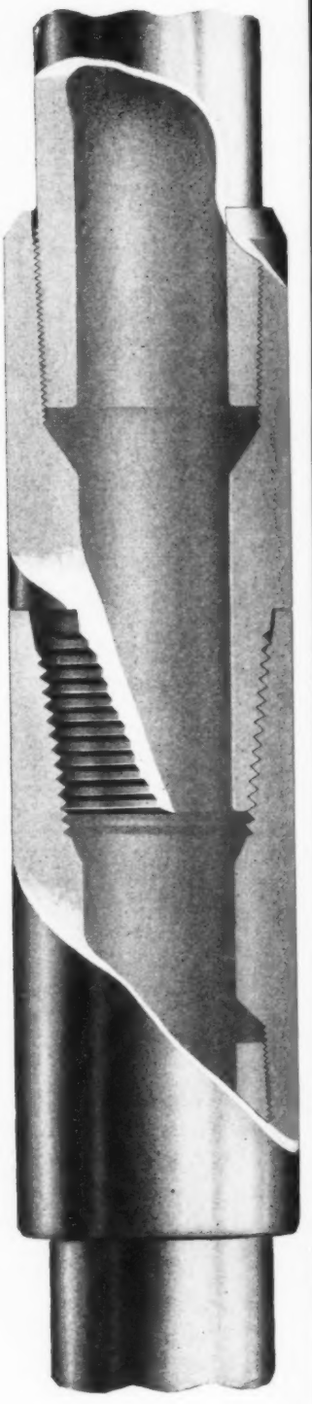
MADE BY TRIMONT MFG. CO., ROXBURY (BOSTON), MASS.

REED FULL HOLE

ADOPTED A·P·I· STANDARD

SEE SUPPLEMENT No. 2 (Sept., 1934) TO A. P. I. STDS. No. 7-B

OFFICIAL RECOGNITION OF THE PROVEN ADVANTAGES



- FREER MUD CIRCULATION AIDS IN KEEPING LONG DRILL STEMS FROM GETTING STUCK
- INCREASED DRILLING SPEEDS
- LOWERED MUD PUMP UPKEEP COSTS
- INCREASED DRILLING BIT EFFICIENCIES
- LOWERED FISHING HAZARDS
- FACILITATES RUNNING OF SURVEYING INSTRUMENTS AND WIRE LINE CORE DRILLS

TOOL JOINTS

PIONEERED

DEVELOPED

AND NOW

STOCKED

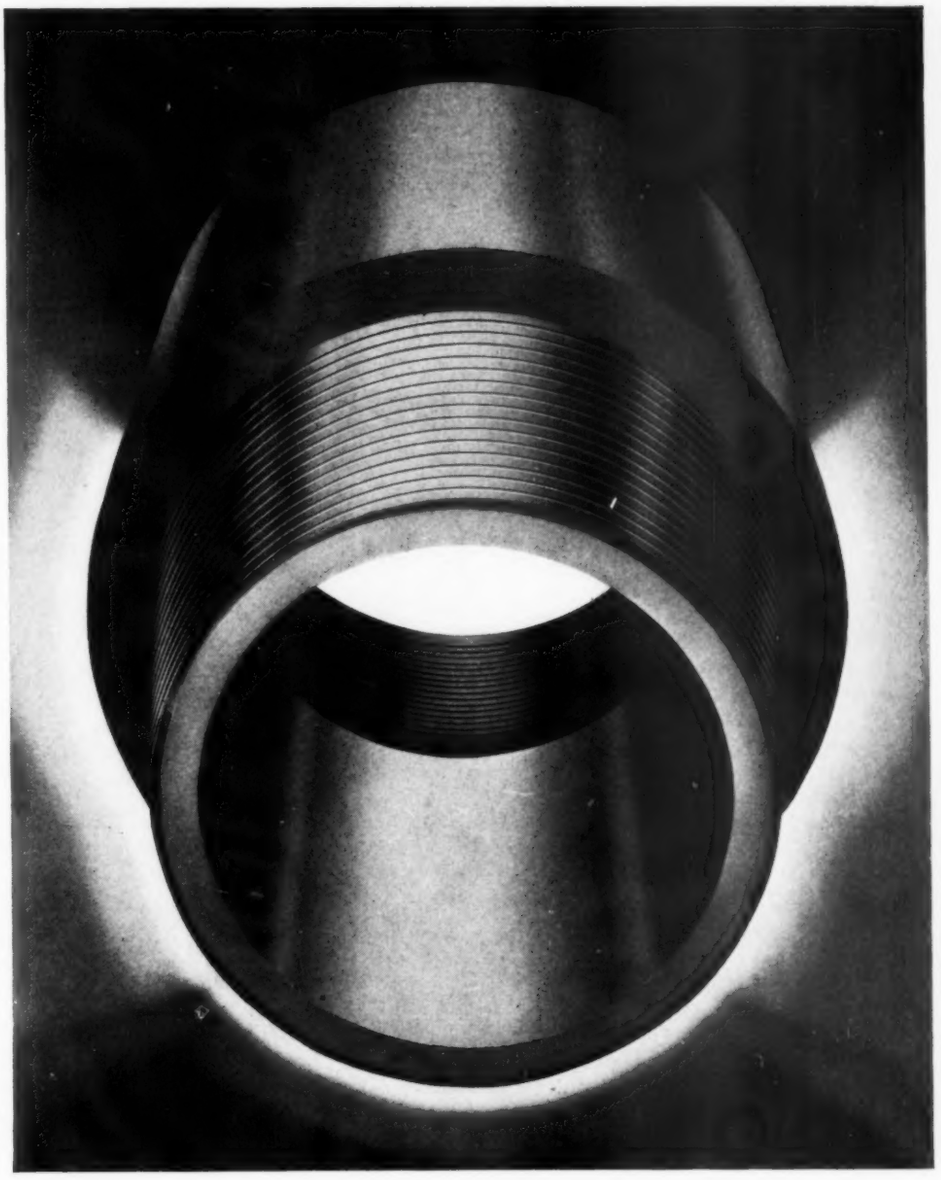
TO

IMMEDIATELY

FILL YOUR

REQUIREMENTS

by



REED ROLLER BIT CO.

The Reed Roller Bit Company is a member of the Code of Fair Competition for the American Petroleum Equipment Industry and Trade.

LOS ANGELES
1317 Esperanza Street

HOUSTON
Main Plant. P. O. Box 2119

OKLAHOMA CITY
1129 Southeast 29th St.

Kilgore, Texas

Lake Charles, Louisiana

Export Office, NEW YORK, 150 Broadway

London Representative's Office: LONDON, ENGLAND, E. C. 2 Coventry House, South Place

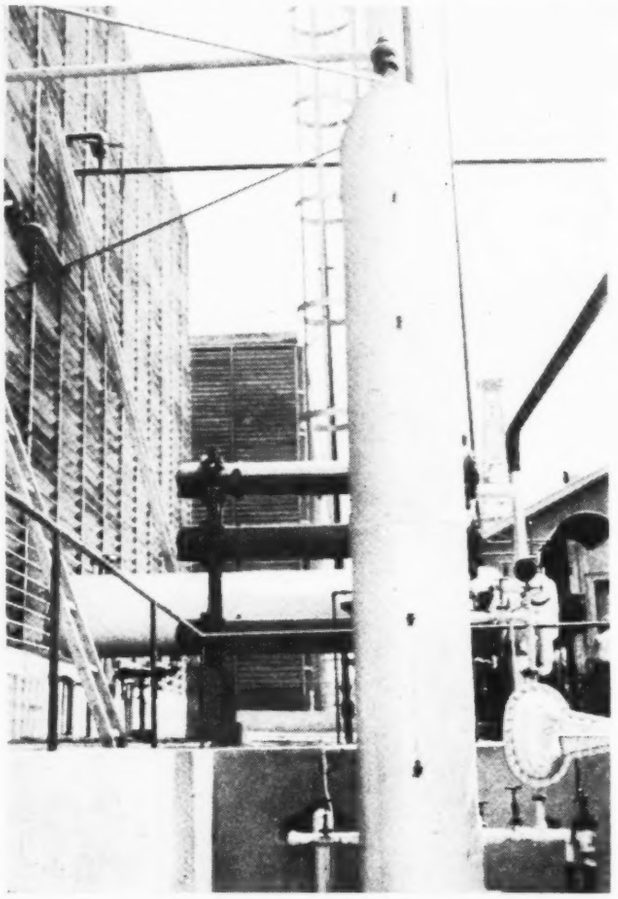
Mid-Continent and Gulf Coast Distributors for MARTIN-DECKER PRODUCTS

DISTRIBUTED THROUGH SUPPLY STORES EVERYWHERE

Safety Vent For Fractionator Outlet In Gasoline Plant

By J. C. ALBRIGHT

A DISASTROUS fire that resulted in the loss of a large amount of property and several lives of the employees on duty at the time, occurred recently in a gasoline plant in California. The cause was attributed, supposedly, to a reduction valve sticking on the stabilizer outlet line as a result of the packing gland being screwed up too tight. Since this experience the Gilmore Gasoline Company in its plant at Signal Hill has placed on the stabilizer outlet line that carries the finished gasoline from the Braun column to the storage tanks, an apparatus that will prevent a sudden increase in pressure on the storage tanks should there be a failure of a control in their plant.

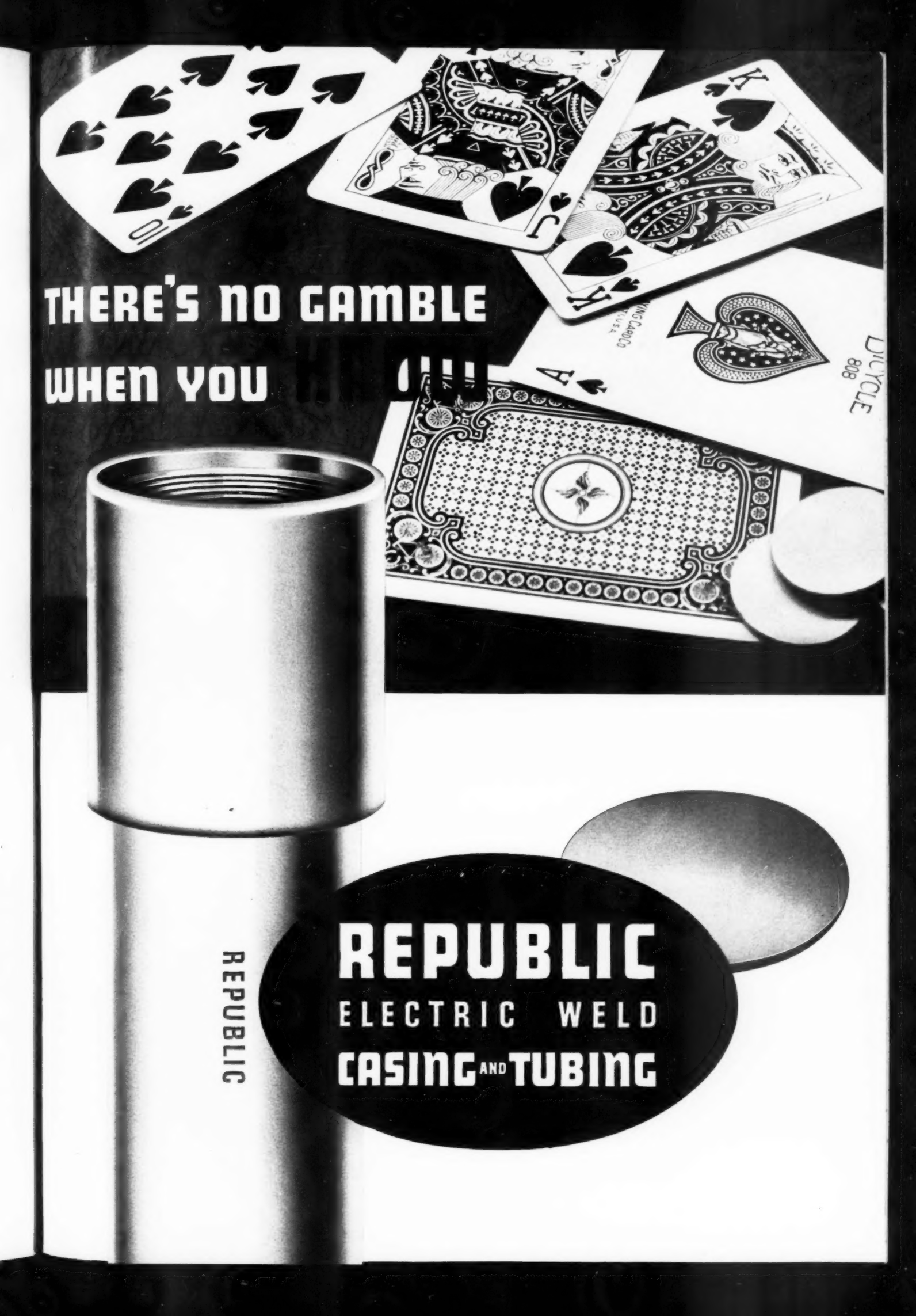


In previous practice, the regulating valve, which released the liquid from the base of the fractionator running directly to the vertical storage tanks, controlled the level in the column and permitted the gasoline to flow from a process pressure of 190 lb. gauge to a storage pressure of 30 lb. gauge, as it was processed to the desired vapor pressure or recovery specifications. When the change was made, this valve was left in the same position, and performed the same function as before, but in addition to this apparatus a balancing tank was placed directly in the line between the reduction valve and the storage tank distribution header. This balancing tank serves two purposes; that of forming a receptacle for the gasoline as it is released from the reduction valve and that of supplying a gas separator and excess pressure release on the transfer line and storage tanks.

In designing and fabricating this safety feature, advantage was taken of an obsolete fractionator column that had been replaced by a more modern one. This column was cut in two so that the desired portion was about 20 ft. in length. The open end was closed by welding an orange peel head in which was placed a 3-in. collar, leaving the base as it was while in previous service. Of course, the plates were removed so that it presented a hollow shell without any restricting surfaces in the interior. The proper fittings were welded in the shell near the base plate for the intake of the gasoline, and on the opposite side, fittings were supplied so that a heavy duty float could be assembled in a regulation liquid-level control loop. A 3-in. Scott relief valve was placed in the collar, and the vent line, leading from it, was placed in the near-by louvre tower to permit the escape of gas should this valve be called upon to function.

When this safety apparatus is placed in operation, the lines connecting both sides of it are opened so that the gasoline, in traveling through to the proper storage tank, is unrestricted in the flow after it has been reduced in pressure by the ½-in. Wilgus remote controlled valve, which maintains a predetermined level of gasoline being processed in the fractionator. The heavy-duty Fisher float on the outlet side of the small tower controls a balanced valve that remains open so long as there is a passage of liquid through the system. The float riding upon the level of the gasoline in the column will remain in that position and maintain an open condition of the balance valve, but if for any reason gas should come through the separator, or small tower, in quantities and with elevated pressure, the gasoline would be forced out faster than it would be received, so the valve on the outlet would close immediately. Should the pressure coming into the small column rise ten lb. above the normal working pressure, the safety valve on top will release the excess gas and pressure to the stack without any appreciable increase in pressure on the storage tanks.

Fortunately, this piece of equipment has not been called upon to function because of failure of any of the other parts in the fractionating apparatus, but the safety valve set on top of the separator is tested each day to prevent the valve from freezing to its seat. To make this piece of equipment more safe in operation, it occurs to the writer that if an automatic steam valve, which would be operated immediately upon the opening of the relief valve, were placed in a line leading to the outlet of the vent stack, steam in sufficient quantities would be released that would effectually smother any flame that might be propagated.


THERE'S NO GAMBLE
WHEN YOU
REPUBLIC
ELECTRIC WELD
CASING AND TUBING
REPUBLIC

INSPECTED INSIDE TOO

Three years ago, Republic introduced Electric Weld Casing and Tubing. Sales progress at first was slow. Buyers were justifiably sceptical. They asked for facts, and we gave them. We made no attempt to hide the fact that this product was welded. On the contrary, we made sales capital by proving the weld 100% perfect. We showed that only by the Republic Electric Resistance Welding Process could pipe be made commercially that possessed the attributes of straightness, roundness, and uniformity of wall thickness, strength and size. We played up the fact that, because it was made from clean strip steel and formed cold, it was entirely free from scale. And today, *there is no other method of making oil country casing or tubing that produces a product so definitely free from inside defects,* and known to be so, because the inside surface of every length is inspected as it is formed, right up to the point of welding.

Split a length of pipe produced by *any* hot-rolled process, compare the inside with Republic Electric Weld, and draw your own conclusions.

Records show that nine and one-half million feet of Republic Electric Weld Casing and Tubing has been set by leading producers in all fields during the last three years.

May we send you additional facts?

REPUBLIC
ELECTRIC WELD
CASING AND TUBING

The Significance of Light Translucency

Of Thin Adsorbed Films of Lubricants and Other Oil or Oily-Feeling Products

By S. FISCHER, JR., and EDWARD MARINOFF

Article V

FINAL CONCLUSIONS

PRELIMINARY EXPERIMENTATION

UNDER the conclusions following the preliminary experiments, most of the data have been discussed with the exception of interpreting the common point of intersection for Percentage Light Translucency—Gravity (A.P.I.) relationships of Pennsylvania, paraffin base oils. See Fig. 2a (Article I, July).

This point is identified with an A.P.I. gravity of 28.5 deg. and a percentage light translucency value of 81 per cent and may be interpreted to mean: that, irrespective of its mode of treatment, any Pennsylvania, paraffin base oil having an A.P.I. gravity of 28.5 deg. will have a percentage light translucency value of 81 per cent.

SPECIAL EXPERIMENTAL WORK

Percentage Light Translucency and Viscosity (S. U.)

1. The relation existing between these two quantities for Pennsylvania, paraffin base oils, seems to indicate, very markedly, that the graphs plotted may serve the purpose for determining the mode of treatment employed in the preparation of the final, marketable product. The longer the application of high temperatures during the processing, the lower will be the percentage light translucency. See Curves I, II, III, and IV, Fig. 5 (Article II, August). Here, Curve I, with the exception of oil No. 14, and Curve II in toto represent vacuum-distilled oils,—oils where high heat has been applied only for minutes, while Curves III and IV represent oils treated over a long period of time (36 to 48 hours) at high temperatures. Curve V, represents oils subjected to intense filtration.

2. For Pennsylvania, paraffin base oils: the greater the heat applied and the greater the duration of application of such heat, the greater will be the loss of percentage light translucency, due to actual chemical decomposition of useful constituents in the oil.

3. For Pennsylvania, paraffin base oils: the higher the degree of filtration, the greater is the loss of the percentage light transluency, in all likelihood, due to filtering out of useful components of the oil. See Curves III and V, Fig. 5 where the oils used for obtaining Curve III are the oils from which the highly-filtered oils composing Curve V have been obtained.

4. Percentage Light Translucency — Viscosity (S.U.) curves lend themselves better for detecting "off" oils than do Percentage Light Transluency—Gravity (A.P.I.) curves. See Fig. 4a and Fig. 4b and Fig. 5, Curve I, oil No. 14, (Article I, July).

The Common Point of Intersection of Percentage Light Translucency-Viscosity (S.U.) Relationships for Pennsylvania, Paraffin-base Non-Highly-Filtered Oils:

1. The existence of this common point of intersection has been verified. See Fig. 7 and photographs A, B, and C in Figs. 9a and 9b (Article II, August). This point is identified by a viscosity of approximately 63.8 sec. at 210 deg. fahr. (S.U.) and a percentage light translucency in the vicinity of 76 per cent. Photo. C in Figs. 9a and 9b (Article III, September) represents a Pennsylvania, paraffin base oil of viscosity of 65 sec. at 210 deg. fahr. (S.U.), showing practically no carbon formation for an oil of such a viscosity.

2. The interpretation of this common point of intersection appears to be: that, with the exception of highly-filtered oils, irrespective of the mode of treatment, any Pennsylvania, paraffin base oil having a viscosity of approximately 63.8 sec. at 210 deg. fahr. (S.U.) will have a percentage light translucency of about 76 per cent.

The Significance of Durability of Percentage Light Translucency

1. According to actual run tests (see curves in Fig. 6 and Fig. 7), it is evident, that the Pennsylvania, paraffin base oils show a lesser breakdown in the percentage light translucency than do naphthene base oils, run under the same conditions.

2 It appears that the loss in percentage light translucency is an indicator as to the relative degree of chemical decomposition of oils.

3. If the chemical decomposition of an oil, like in practically all other cases, is an indication as to the stability of an oil, then the measurement of the percentage light translucency is a measure as to the relative durability of an oil. Again, see Fig. 6 and Fig. 7 as to percentage light translucency breakdown.

4. Of interest, in this connection, are the following two oils:

	Sample	Percentage Light Translucency	Percentage L. T. Increase
1.	Pale Oil	49.03%	
	Same Oil Edeleanu-treated	69.66%	20.63%
2.	Pennsylvania, paraffin base oil	77.69%	
	Same Oil specially-treated (treatment unknown to authors)	89.51%	11.82%

These oils were tested under operating conditions and the authors were informed that the treated oil, in each case, had a decided greater durability than the initial stock. These oils were tested by two prominent oil companies.

Types of Light Translucency of Thin Adsorbed Films of Oily Substances:

1. It would seem that one will have to segregate the light translucency of thin adsorbed films of oily substances, as used by the authors, into two classes, either in terms of practical usefulness or in terms of stability. The first classification would yield useful and non-useful light translucency and the second, stable and less stable light translucency.

2. The classification as to usefulness under practical conditions would naturally be a function as to the particular industry for which the oils are to be used, such as the field of lubrication, the field of medicine, paint and varnish industry, etc.

3. The classification, as to the degree of stability, appears to the authors as being better, at least as far as the art of lubrication is concerned. The best standard as to this stability is the actual use of the oil in practice. On the other hand, it is not too far-fetched to make the statement here, that the oil that will maintain the same percentage light translucency over the greatest range of temperature will be the most satisfactory oil for any given cause.

4. The stability, it would appear, is also a function of the degree of unsaturation of those compounds possessing light translucency in terms of thin, adsorbed films. In this case, those oils, having more compounds approaching more closely a more-saturated series of organic compounds, would have the greater stability as regards their components possessing the desired percentage light translucency. If the compounds were of the paraffin series type, they would be possessed of the maximum stability in percentage light translucency.

5. The initial percentage light translucency is not necessarily a criterion as to the possible value of the oil for lubrication. In Fig. 6, oils IV and V have a high initial percentage light translucency but a comparatively low value after having been subjected to a run of 500 miles under the stipulated conditions. Evidently, the initial percentage light translucency of these oils, namely, 84.82 per cent and 84.23 per cent, respectively, was not indicative of the breakdown found by experimentation. On the other hand, oil I showed a percentage light translucency lower than either of the oils IV and V, namely, 83.66 per cent and yet, upon running under identical conditions, showed a much smaller breakdown.

6. Therefore, the authors feel that the percentage light translucency-temperature test is a true criterion as to the stability of lubricating oils under practical use, because by its means, the point of breakdown of an oil can be determined. The higher this breakdown temperature, the more stable is the light translucency and therefore the more stable would the oils appear to be as the graphs would show in Fig. 6.

Heat and Percentage Light Translucency of Thin, Adsorbed Films of Oily Substances:

1. It is believed true, that the more readily an organic compound breaks down upon application of heat, the less is its stability or durability. According to Fig. 8, it is apparent that oily substances breakdown at lower or higher temperatures, meaning indirectly at lower or higher heats. Therefore, those oils, whose percentage light translucency is high and is maintained constant over a greater temperature range than others, must have the greater stability in terms of this property.

Carbon Formation and Percentage Light Translucency:

1. Fig. 8 shows the nature of the breakdown of the percentage light translucency graphically as measured in this series of articles. Fig. 9a and Fig. 9b, photographically, show the carbon formation of various oils due to heat. Table No. IVa shows this loss in terms of percentage light translucency. Therefore, the measurement of the percentage light translucency of oils after the oils have been subjected to various temperatures, is a criterion as to the possible carbon formation of such oils upon use.

2. Pennsylvania, paraffin base oils, upon heating, show very little, if any, breakdowns, in terms of carbon formation for viscosities above the value associated with the "common point of intersection" described heretofore, that is, above a viscosity of 63.8 sec. at 210 deg. fahr. While below this point, the carbon formation, with an increased loss in percentage light translucency, is clearly shown in Fig. 7, Table No. III, and substantiated by the photographs, A, B, and C, Fig. 9a and Fig. 9b and Table No. IVa.

Percentage Light Translucency and the Neutralization Number:

1. It may be assumed, primarily, that the amount of increase in neutralization number upon application of heat is indicative of the degree of chemical changes within the oil, as far as acids formed are concerned.

2. It would appear that from the neutralization number considered in conjunction with the percentage light translucency, one could conclude that:

(a) In the course of heating, if the percentage light translucency remains constant and there is an increase in the neutralization number above that of the original oil, the total increase of the neutralization number, as far as acids formed are concerned, then solely is due to the decomposition of non-light translucent constituents. See Table No. Va, oil No. 29.

(b) It would appear then that where an oil changes in percentage light translucency with application of heat the increased neutralization number would then be due to the acids formed from the decomposition of the non-light translucent constituents plus those formed from the decomposition of the light translucent constituents. See Table No. Va, oils No. 28 and 40.

3. This phase is being worked upon more in detail at present in order to establish the behavior in respect to neutralization number and percentage light translucency of oils, as far as oils having slight alkalinity are concerned, and whether or not quantitative determinations can be made as to the respective decompositions of the non-light translucent and the translucent constituents.

Processing and the Percentage Light Translucency of Thin, Adsorbed Films of Oily Substances:

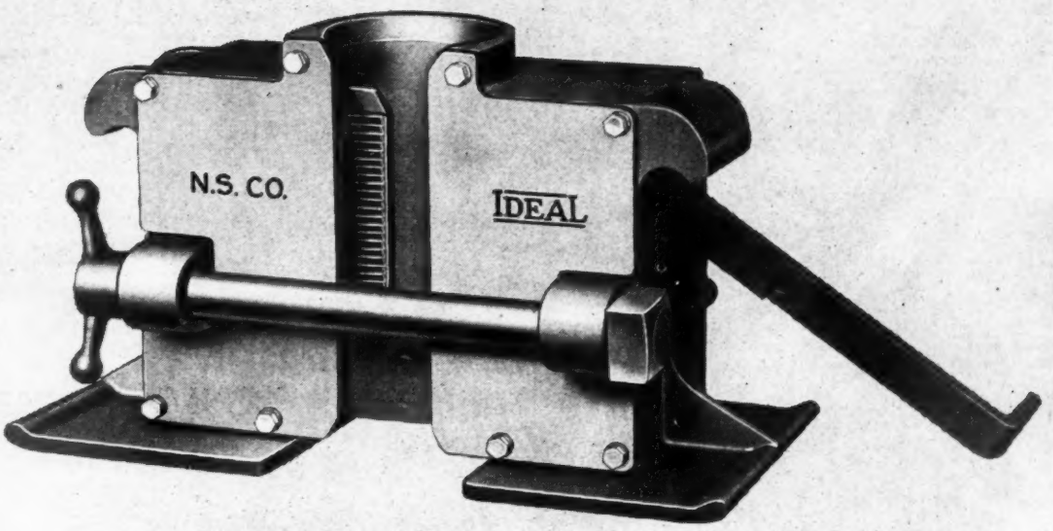
1. For Pennsylvanian, paraffin base oils, processing may be determined by a study of the Viscosity (S.U.)—Percentage Light Translucency relationships as discussed under the "Percentage Light Translucency and Viscosity (S.U.)". See Fig. 5.

IDEAL

"Reg. U. S. Pat. Off."

TUBING SPIDER

TYPE D-2



A ruggedly constructed, all-steel, two-slip spider, designed to handle long, heavy strings of tubing with the utmost safety, speed and convenience.

Built with a working capacity of 100,000 pounds, and for 2, 2½ or 3-inch tubing.

Bulletin No. 50 free on request.

THE NATIONAL SUPPLY COMPANY

When there is plenty of tough hauling to be done, put International Trucks on the job. That is what the B. F. Walker Company of Houston and Longview does. This picture shows one of their twenty Internationals moving a boiler.

INTERNATIONAL TRUCKS ARE ALL TRUCK

In every inch of Design
In every ounce of construction

TRUCK quality must be of a different stamp than PASSENGER-CAR quality. Truck users want rugged stamina, for rigorous service! That is why you have lately seen in the truck advertising of some manufacturers so much talk of "all truck." They are aiming to satisfy the demand. But they are only now claiming what International Trucks have *delivered* for many years — EXTRA capacity for taking punishment and giving value.

For more than twenty years the International Truck builders have built *only trucks*. No automobiles — no tempting opportunity to compromise. The new streamlined Internationals, with all their beauty of line, give you International ALL-TRUCK QUALITY. Sizes from ½-ton up, chassis prices f. o. b. factory from $390 up, at all International branches and dealers.

INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. **OF AMERICA** *(Incorporated)* **Chicago, Illinois**

This is one of the new streamlined International Trucks from which you can expect new values in utility and performance. Take Harvester's word for it — the quality apparent on the surface is more than matched by the quality underneath. It is the *extra* quality that International Truck owners have banked on for more than thirty years.

2. Vacuum treatment of such oils appears to be most efficient from the angle of maintaining both high and stable light translucency of the compounds initially in the oil possessing this property. Heat treatment over a long period of time seems to decompose some of these compounds, while high filtration seems to filter out some of these useful components giving a lower percentage light translucency value. See Fig. 5 and Table No. I.

3. The Percentage Light Translucency — Temperature curves, once one becomes familiarized with them, will lend themselves well for interpreting treatments of a certain type. For example, the authors would encounter no difficulty in determining whether or not an oil has been treated by the Edeleanu process, provided the initial stock as well as the treated oil were made available, because this process will always increase the stability of the light translucency in a certain manner for Naphthene and Mid-Continent base oils. See Fig. 8, Curves V and XII, and also Fig. 10, Curves III and V, which are for Edeleanu-treated oils.

4. The Edeleanu process, being a "selective-solution" process, it appears to the authors that they will experience no difficulty in classifying, by experience, the new solvent processes coming into vogue at the present time, in terms of percentage light translucency of thin, adsorbed films.

5. Alkaline clay-filtration of naphthene base oils can readily be detected by: first, a study of the Percentage Light Translucency—Viscosity (S.U.) curve indicating high initial values of percentage light translucency; and, secondly, a study of the Percentage Light Translucency—Temperature curve which would designate the unstability of the high initial percentage light translucency values of such oils.

Increasing and Rejuvenating the Percentage Light Translucency Property of Oils:

1. The authors' two processes, designated as Process 1 and Process 2, differ essentially from the modern "selective solvent" processes, in that nothing is removed from the oil processed. The principle consists in converting as many of the components not possessing the property of light translucency, naturally contained in the oil, into such compounds that will possess this property.

2. Both processes increase the percentage light translucency value and enhance the stability of the percentage light translucency. See Fig. 10 and Table VI.

3. The processes work on new oils of any base advantageously, and it appears that it can be applied successfully to used oils. See Fig. 10. May the writers be permitted to draw attention to the results obtained in treating a used transformer oil by one of their mentioned processes:

	Neutralization Number (milligrams KOH per gram of oil)	Percentage Light Translucency
Used, filtered and dehydrated transformer oil	1.26	59.34
Same oil treated by Process 1	0.42	93.12

Work Under Investigation in Connection with the Property of Percentage Light Translucency of Thin, Adsorbed Films of Oily Substances:

While much remains to be done in the fields of investigation mentioned, some conclusions may be drawn at the present time.

1. If the further investigations as to the kinetic coefficient of friction, the surface tension of oils, and their related effects to the percentage light translucency of thin, adsorbed films of the oils, prove as successful as they so far appear to be, then the measurement of the Percentage Light Translucency—Temperature relationship will offer a means to ascertain quickly the value of an oil for lubricating purposes, incorporating all these properties in a single test.

2. If, as previously mentioned, the initial percentage light translucency value is no criterion as to the ultimate value of a lubricating oil, then the initial, kinetic coefficient of friction and the initial surface tension, as the results so far indicate, are not the crucial values to gauge an oil by, but rather the retentivity of the useful kinetic coefficient of friction as well as the retentivity of the useful surface tension over the longest period of time for a given operating condition. See Tables No. VIIa, VIIb and VIII, also Fig. 11.

USES OF THE UNCTUOMETER

1. Primarily, the Unctuometer is used for the measurement of the degree of light translucency of thin, adsorbed films of oily substances.
2. The Unctuometer can be used in control of refining, blending and compounding of oils.
3. The Unctuometer can be used in the detection of adulteration of oils.
4. By the simple and rapid means of the Unctuometer, the "Percentage Light Translucency—Temperature" determinations will serve, within practical limits, as an indication of the durability of any oily substance, lending itself as a joint measurement as to the stability of such other vital properties as kinetic coefficient of friction, surface tension, etc.
5. Application of the Unctuometer may be found in other industries where oils are used for similar purposes and other purposes such as adsorption, etc.

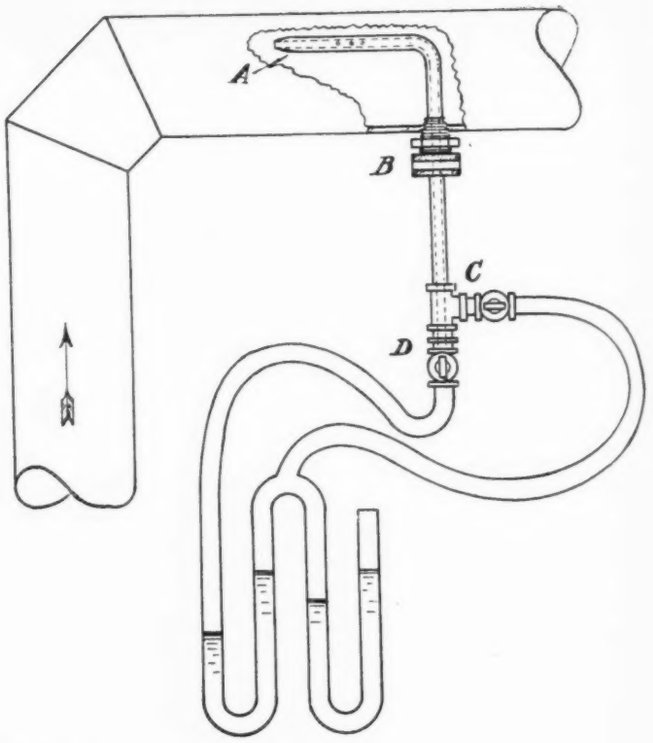
Relation of Light Translucency of Thin, Adsorbed Films of Oily Substances to the Property of Oiliness

Finally, if it is accepted by the science and practice of lubrication,—(a) that the definitions quoted by the authorities under "Literature Concerning the Definition of Oiliness" are correct; (b) that Oiliness is coincident with the durability of an oil; (c) that Oiliness must be measured independent of the viscosity, coefficient of friction, etc., of the oil,—then the authors feel that their work in its entirety has, in no manner, shape or form, deviated from these findings, but has actaully substantiated them. Therefore, the authors cannot help but offer the fact that this measurement of the percentage light translucency with the Unctuometer measures the Oiliness of oily substances; and that the measurement and examination of the Percentage Light Translucency—Temperature relationships offer a rapid and simple means for determining the durability of such substances.

Might the writers suggest that, due to the fact that there exist substances possessing useful and non-useful oiliness, the term "luboiliness" be applied to those substances possessing oiliness of value to the art of lubrication.

[*Editor—This concludes this series of articles.*]

Fig. 1



By

EDWARD
M.
RAUH

Accuracy of Pitot Tube Measurements Near Points of Disturbance*

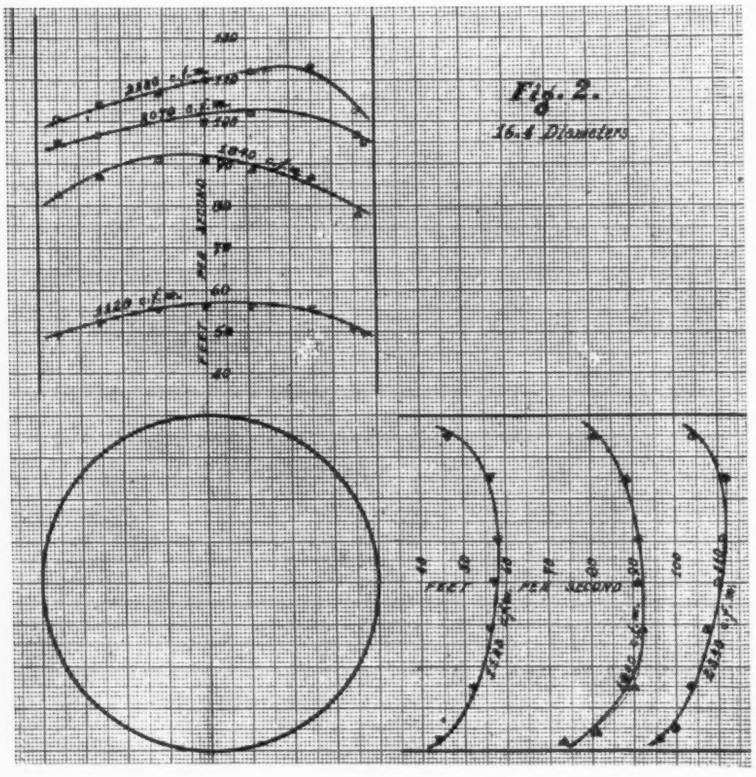
A COMMON field method of measuring the velocity of a gas in a pipe line is the use of a pitot tube. This instrument consists of two small pipes, one inside the other (See Fig. 1), and bent to form a right angle. One end of the pipes is so sealed that the annular space between them at that end is shut off from the inside of the smaller and the outside of the larger, and is so dressed that when pointed against the stream of the gas, the gas will flow smoothly past the outer pipe as at "A", Fig. 1.

"B" is a nut in which the tube is free to slide in a packing, and is the means for inserting the pitot tube for use in a pipe line.

The inner pipe extends through the other end of the outer pipe at "D", where it is again sealed off from the annular space. To this end is attached a gauge cock for the connection of a Bourdon gauge or a manometer. About midway between "A" and the right-angle bend are drilled some small holes, symmetrically spaced around the outer pipe. These side openings connect the space in the line with the annular space in the pitot tube. At "C", by use of a tee, the annular space is connected to another gauge cock.

The total pressure under which a fluid in motion exists consists of two parts: (1), static pressure, and (2), velocity pressure. In the measurement of the velocity of a gas in a line or duct, both must be known. The static pressure may be measured directly by means of a Bourdon gauge or a manometer attached at "C". The velocity pressure, however, must be determined indirectly.

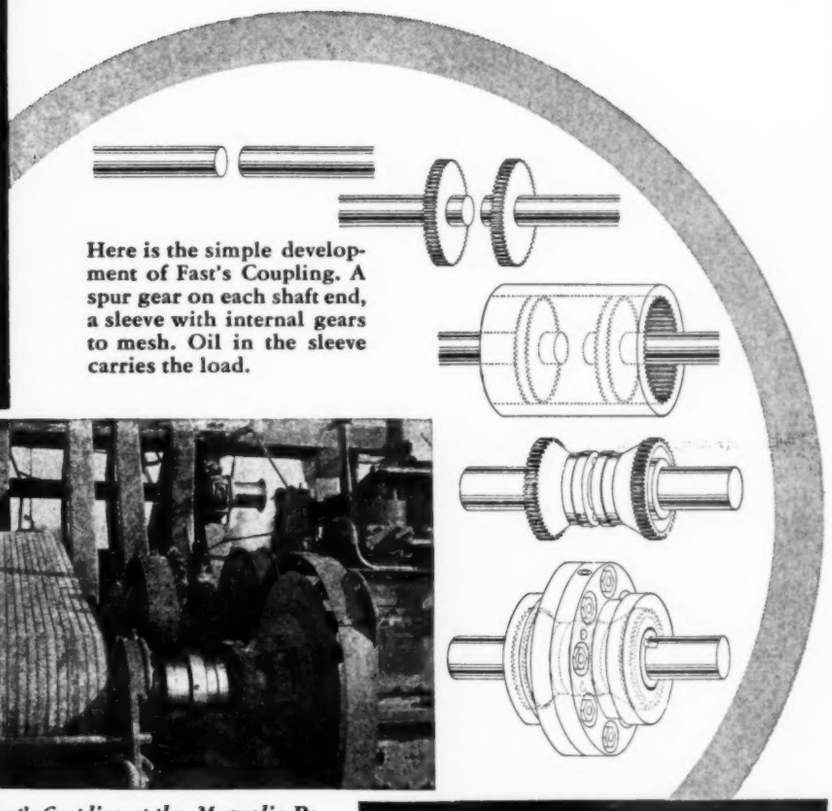
A gauge of some sort connected at "D" will measure what is known as the dynamic pressure. This is the sum of the static and velocity pressures.



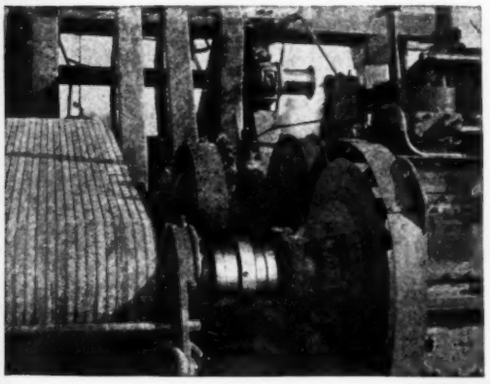
*This article is the substance of a report on a research problem to determine the effect of disturbance caused by bends, transmission cones, etc., on the accuracy of pitot tube measurements. The work was done by the author as an engineering student at the University of Oklahoma, Norman, Oklahoma, during the early part of this year.

SPECIFY FAST'S *on New Equipment*

Stop Coupling Shut-downs



Here is the simple development of Fast's Coupling. A spur gear on each shaft end, a sleeve with internal gears to mesh. Oil in the sleeve carries the load.



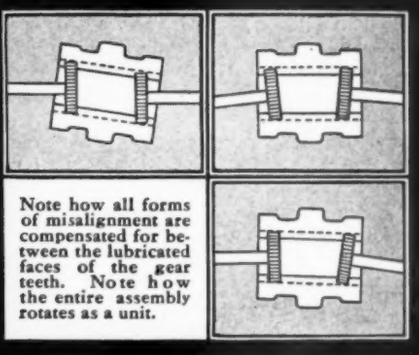
Fast's Coupling at the Magnolia Petroleum Corporation, Wewoka, Okla.

FAST observed that nearly all coupling shut-downs, with their attendant loss of time and stopping of production, were caused by the failure of a flexible pin, spring, disc, washer or grid. "Why not do away with these flexible parts?" he asked. "Then we will do away with coupling shut-downs."

The diagram will show you how well he succeeded. Not a single flexible part to fatigue or fail. Not a single part that must be replaced periodically. Nothing but a simple mechanical assembly, in which all forms of shaft misalignment are compensated for between the lubricated teeth of generated gears. The oil carries the load; there is nothing to wear out.

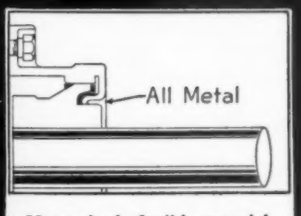
Such a simple assembly will last as long as the connected machines, when oiled periodically like any other piece of transmission equipment—and be utterly free from all the causes that bring on shut-downs.

Wouldn't it interest you to save thousands of dollars for your plant by abolishing coupling shut-downs? Then write today for our catalog that shows a Fast Coupling for almost every need of industry and contains further information about Fast's Self-Aligning Couplings.



Note how all forms of misalignment are compensated for between the lubricated faces of the gear teeth. Note how the entire assembly rotates as a unit.

Permanently Dust-proof



Not a single flexible material, not a single rubber or felt washer is used in Fast's Coupling. All metal to metal contact prevents dust, grit, fumes, or moisture from getting into the working assembly. Due to this exclusive principle, Fast's Couplings never cause shut-downs because of internal wear due to foreign substances.

FAST'S *Self-Aligning* COUPLINGS

THE BARTLETT HAYWARD COMPANY

SCOTT AND McHENRY STS., BALTIMORE, MD.

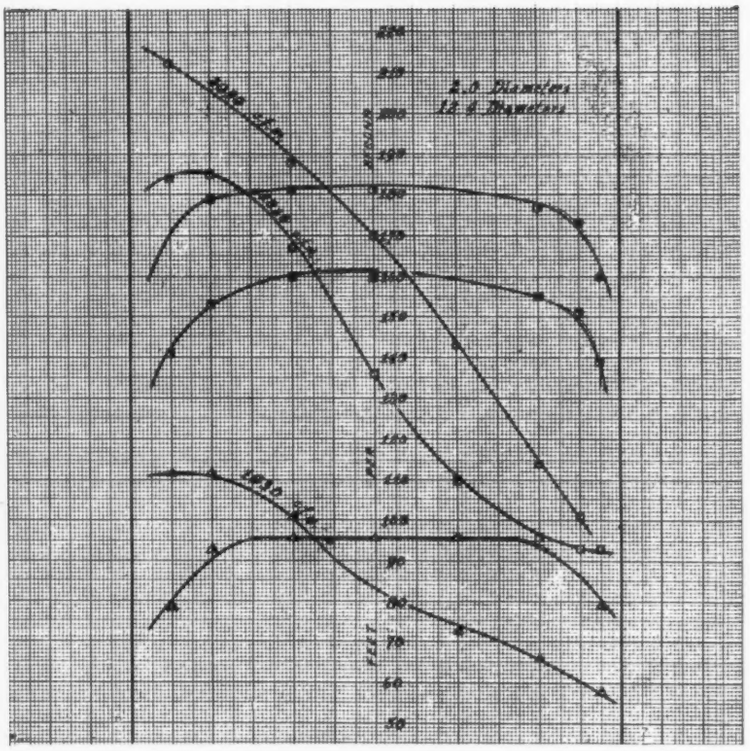


Fig. 3

By reading gauges at both connections ("D" and "C") and taking their difference, the velocity pressure is obtained.

For a case of comparatively low pressures inside the pipe line, both velocity and side static pressures may be read directly and simultaneously if the manometers are connected as shown, the one on the left indicating velocity, and the other, side static pressure, in terms of the fluid in the manometers.

From the physics law of free fall, the relation:

$$V = \sqrt{2gh}$$

is obtained in which "V" is the velocity of a mass of matter after having fallen from a state of rest through a distance "h". The term "g" is the acceleration due to the action of gravity and in the English system of units is 32.2 ft. per sec. per second. "V" and "h" are expressed respectively in ft. per sec. and feet.

Reasoning in a reverse order, if a mass of matter is moving with a velocity "V", it may be thought of as having acquired that velocity by falling from a state of rest through a distance "h".

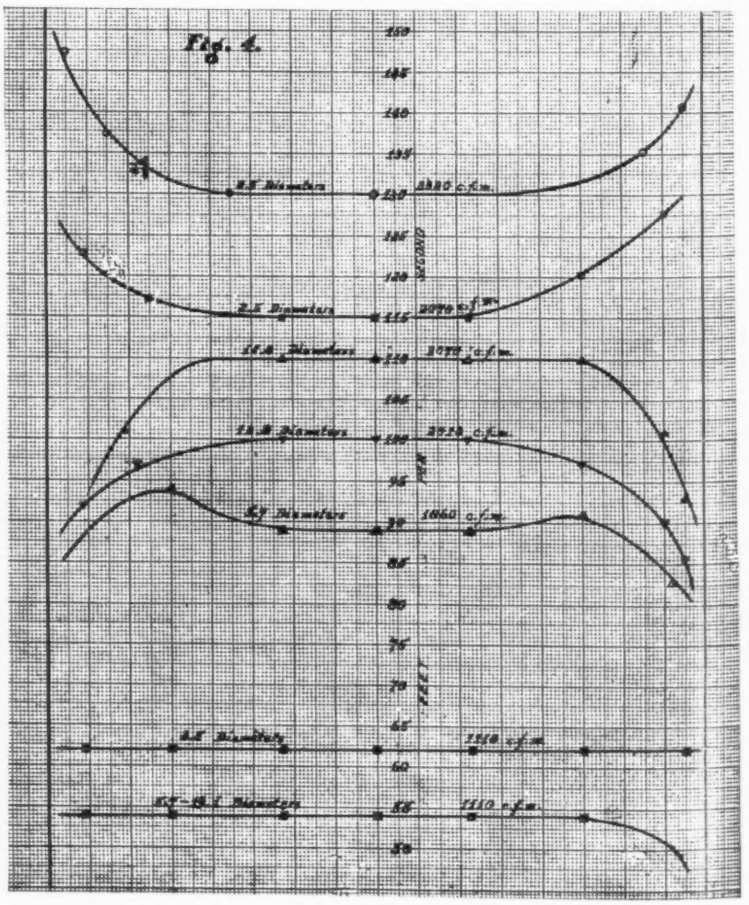
If the difference in the two gauge readings referred to above is expressed in ft. of the fluid being measured, and that numerical value substituted in the above equation, the resultant value of "V" will be the velocity of the gas in ft. per second. (For a case of air flowing under low pressure, a fairly reliable value of velocity is obtained if the square root of the "velocity" manometer reading, in inches of water, is multiplied by 70.)

The effect of friction upon portions of a stream of a fluid adjacent to a boundary wall is well known in hydraulic practice. In most cases, the greatest velocity exists at or near the center of the pipe. In Fig. 2 are shown some "velocity traverses" taken at a point in an 8-in line at a distance of 16.4 diameters from a point of disturbance. The disturbance in this case was an elbow similar to that shown in Fig. 1. In practice the average velocity across an entire section of a pipe is taken as approximately eight-tenths (.8) of the maximum velocity at that section, if the reading is taken 50 diameters or farther from a point of disturbance.[1] This value of eight-tenths becomes approximately six-tenths if conditions of flow are such that no turbulence exists in the stream and the flow is more of a viscous nature. In the cases of Fig. 2 the ratio of average to maximum velocities was somewhat higher than that used in practice for turbulent flow.

In Fig. 3 are shown some "traverses" that were taken at a distance of two diameters from a geometrically similar elbow in a 6-in. line. Those that are somewhat symmetrical were taken across a diameter perpendicular to the plane of the intersecting axes of the elbow and the others were run in the plane of the axes. The higher velocities were observed near the "outside" of the bend. The nature of the disturbance caused by an elbow consisting of but two intersecting cylinders was found to be practically the same as that caused by the type illustrated.

The qualitative effect of the elbow upon the flow of gas is shown in Fig. 4. These traverses were taken on diameters perpendicular to the axes of the bend. Immediately "after" the bend, the highest velocities were observed near the walls of the pipe. As the stream proceeds, the action of friction upon the gas retards the stream till the highest velocity again exists at or near the axis of the pipe. In some instances this occurs so as to give a point at

[1] *Principles of Chemical Engineering*, by Walker, Lewis, and McAdams.



THE SPIRIT OF ACHIEVEMENT

Thermoid products are engineered with the same spirit of achievement that has made oil such a vital force in industry.

Only with the most skilled engineering, only with insistence upon best quality products, has the great oil industry advanced to the commanding position occupied today. And only by an insistence upon a similar background of engineering, have Thermoid products won general acceptance.

Back of this well-known trademark—as it appears on a piece of hose, belting, brake lining, or packing—stands an extensive record of testing in the field under actual working conditions. Thermoid products are designed and constructed correctly because there is knowledge back of their building. Thermoid products are dependable because they have been tried. This is a name that guarantees performance. *Buy by that quality mark!*

OIL WELL SUPPLY COMPANY

Branch Stores in all Oil Fields

DISTRIBUTORS OF

Thermoid

PRODUCTS FOR THE OIL INDUSTRY

Including Oil Pumping and Oil Drilling Belt—Rotary Hose—Air, Steam, Welding and Refinery Hose—Packings and Brake Lining

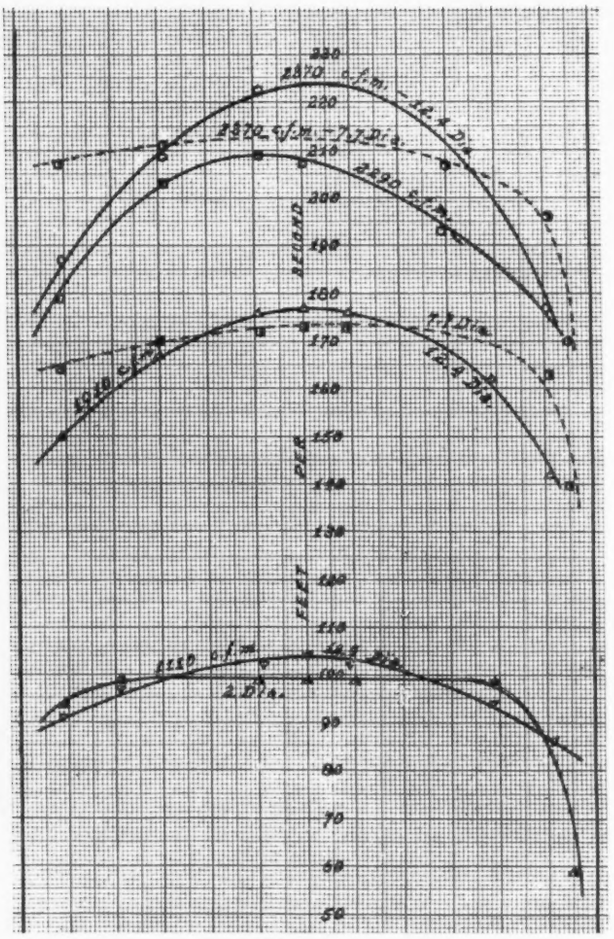


Fig. 5

which a condition of uniform velocity for the section exists. This is exemplified by the curve taken 2.5 diameters from the bend with 1110 cu. ft. per minute flowing. In other instances curves such as that at 5.7 diameters from the bend with 1860 cu. ft. per minute resulted. In general, it was found that the distance from a bend at which the stream "recovers" from the disturbing effects is a function of the quantity passing and the size of the pipe. The distance increases as the quantity passing increases and, when expressed in terms of diameters, it increases as the size of pipe decreases.

In Fig. 5 is shown the effects of a conical transition between an 8-in. and a 6-in. line. Both pipes were on the same axis and the length of the truncated cone connecting them was 21 inches.

In making pitot tube determinations of velocities, and consequently quantities flowing per unit of time, it may be well to run a traverse across a diameter in order to determine whether or not the instrument is in a region of disturbance of the stream. If it is found to be in such a location, and placing it at another point is neither possible nor practicable, the nature of the disturbance must be taken into account in interpreting the gauge or manometer readings.

H. S. McPherson to St. Louis District for U. S. Rubber

H. S. McPherson has been appointed manager of mechanical sales in the St. Louis district for the United States Rubber Products, New York City, it is announced by H. A. Everlien, sales manager of the mechanical goods division. McPherson, prior to the appointment, was in charge of mechanical sales in the Boston district. W. G. Mueller, who has been with the company as a salesman for over 25 years, was placed in charge of the Boston branch.

TRADE LITERATURE

THE LINDE AIR PRODUCTS COMPANY, 30 East 42nd Street, New York, N. Y., has announced a new publication on oxy-acetylene welding. This booklet, "The Maintenance of Reciprocating Parts," deals with the application by the oxy-acetylene process of wear-resisting bronze to the wearing surfaces of sliding parts. Following a brief general discussion, the advantages of bronze-surfacing as an economical and efficient means of reclaiming pistons and similar wearing parts are set forth. Other sections of the booklet discuss frequency of application, characteristics of certain applications, and the importance of wear-resisting bronze welding rod, while the final section is devoted to a complete description of the correct procedure to be followed in the resurfacing operation. Copies will be furnished on request.

AN INTERESTING BULLETIN describing the application of plug valves to oil and gas well drilling has been issued by the manufacturers of Nordstrom lubricated plug valves. It is of particular interest to drillers in the Mid-Continent and California fields. The bulletin is profusely illustrated, showing actual installations of valves on steam and water lines, mud lines, blow-out preventers, Christmas trees and tanks. Illustrations of "drilling through" valves also are shown.

The interesting photographs include installations of round-opening gear-operated valves and types equipped for remote operation by means of tubing and large hand wheels. Specifications, blue-prints and illustrations of individual valves are shown, including standard semi-steel Nordstrom valves, extra heavy, semi-steel valves; also the Emco-Nordstrom valves which have the same face-to-face dimensions as gate valves for the same given size. High-pressure valves up to 5000 lb. test pressure are included. Bulletin "V-100" may be had from Pittsburgh, Pa., or any office of Merco Nordstrom Valve Co.

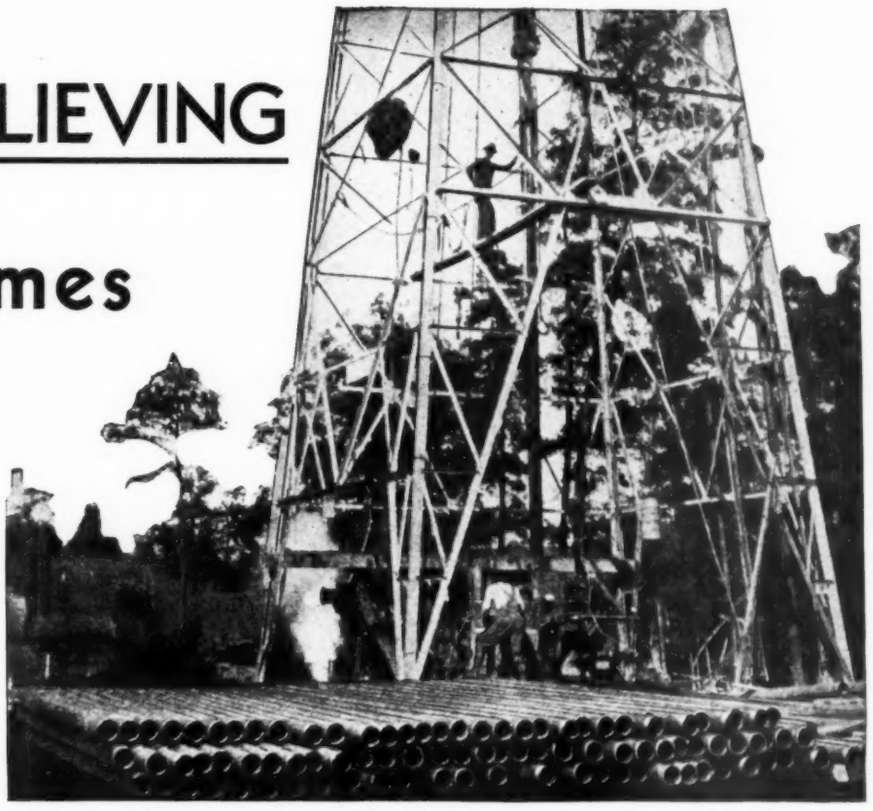
A 16-PAGE BROCHURE released by Republic Steel Corporation, Central Alloy Division, Massillon, Ohio, contains up-to-the-minute data on Enduro 18-8 Stainless Steel, as well as several of the more important variations that make up the Enduro 18-8 series of types. These include Enduro 18-8-S, 18-8-STi, 18-8-SMO and 18-8-FM. Authentic metallurgical and fabrication data is given. An important feature of the booklet is a table of laboratory corrosion data listing the degree of corrosion-resistance of Enduro 18-8 Stainless Steel, Enduro AA and Enduro S to each of more than 300 chemical reagents, solutions and products under varying conditions of temperature and concentration. Copies of Bulletin 125 will be sent upon request to those interested.

THE YOUNGSTOWN SHEET AND TUBE COMPANY, Youngstown, Ohio, extensive manufacturers of oil country tubular goods, has issued a booklet entitled "Matched Thread Perfection." The booklet describes and illustrates the method and tools employed by the company in thread cutting. The system developed by Youngstown produces matched threads on the pipe and couplings. The booklet, No. 18, is available for distribution to those interested.

BULLETIN NO. 112 of the Oil Well Supply Company, Dallas, Texas, describes Imperial No. 50 Single or Double Eccentric Oilbath Geared Power, for pumping oil wells. Photographs and drawings, in addition to a detailed description of the power, are included in the bulletin, which is available upon request.

SEEING IS BELIEVING

when it comes to PIPE



BONA FIDE evidence from the field is the last word when it comes to proving pipe superiority. The photograph shown here pictures current drilling operations where Chester Steel Casing is being run in — and in the words of the superintendent *"Everything is hunky-dory."*

Rigid inspections of Chester Steel Casing, before shipping, guarantee the highest standards of quality and workmanship — adequate stocks at strategic warehousing points mean that you get the pipe you want when you want it.

Try Chester — it means the end of your pipe worries.

Chester also makes "Wrought Iron" pipe — manufactured from genuine old-fashioned hand puddled muck bar made in our own mills from 100% pig iron.

SOUTH CHESTER TUBE COMPANY, Chester, Pa.

District Sales Managers

W. E. Gibson, 801 Columbia Bank Bldg., Pittsburgh, Pa.
H. A. Morse, 30 Church St., New York, N. Y.
J. P. Cooney, 715-716 A. G. Bartlett Bldg., Los Angeles, Calif.
J. P. Steele, 603 Petroleum Bldg., Ft. Worth, Texas.

District Offices

J. D. Swartz, 1231 S. Evanston St., Tulsa, Oklahoma.
E. L. Moseley, 2218 Mills St., Houston, Texas.
Burt S. Shafer, Southwest Representative, 4313 Fairfax Ave., Dallas, Texas, or 603 Petroleum Bldg., Ft. Worth, Texas.

District Warehouses

Houston, Texas; Thenard, Calif.; San Francisco, Calif.

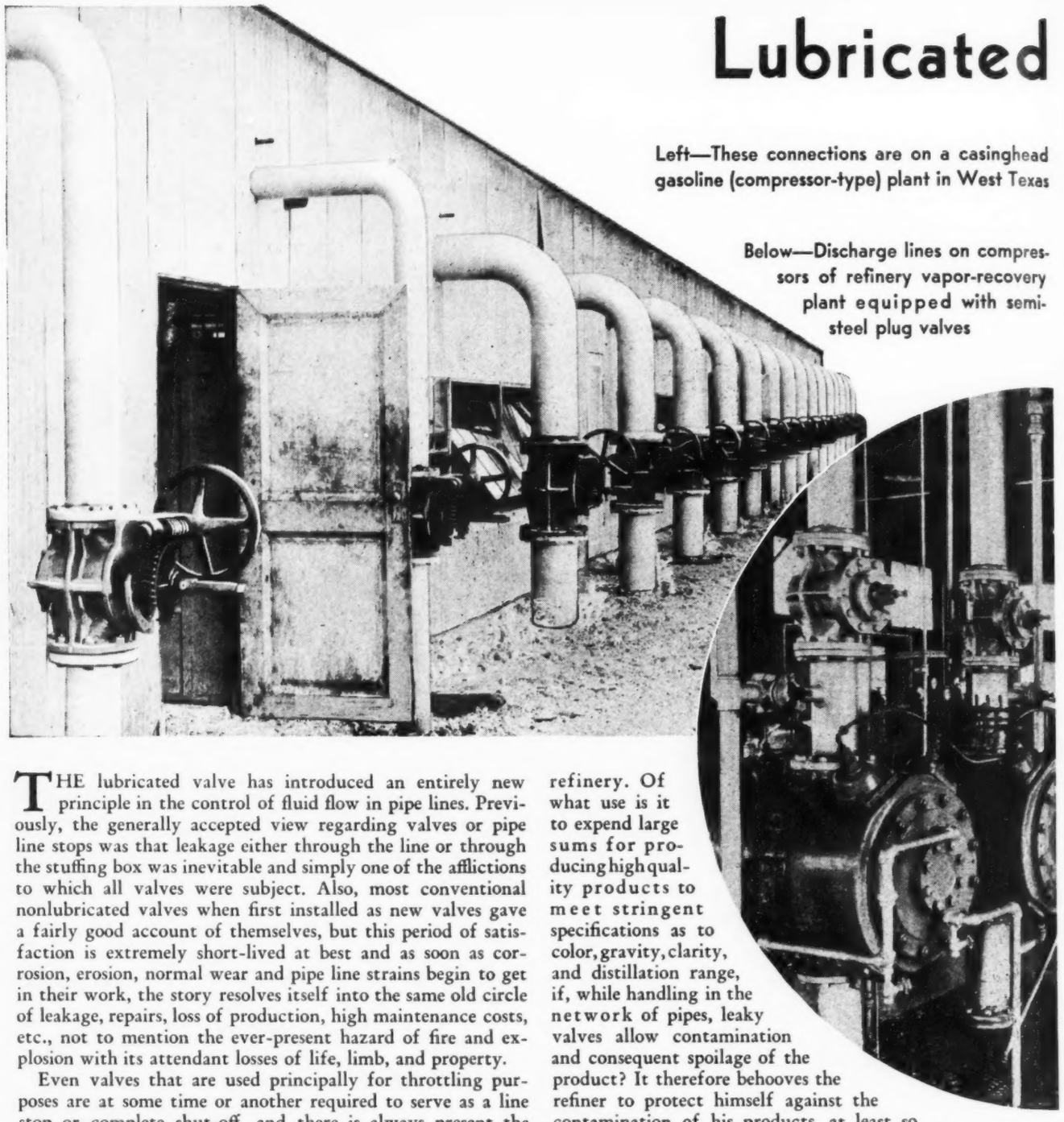
Distributors

United Pipe & Supply Co., Charleston, Danville, West Hamlin, W. Va.; Paintsville, Ashland, Allen, Prestonburg, Ky.
Prichard Supply Co., Mannington, W. Va.; Mather and Waynesburg, Pa.
LeValley, McLeod, Kinkaid Co., Inc., Elmira and Olean, N. Y.
Kane Supply Company, Kane, Lawrenceville, Brookville, Pennsylvania.
Bovaird & Co., Bradford, Pa.
Western Supply Company, Tulsa and Oklahoma City, Okla.; Dallas, Houston, Pampa and Willow Springs, Texas.
Star Drilling Machine Co., 550 Clinton St., Portland, Ore., and Akron, Ohio.
Stephen H. McCabe, 508 4th St., San Francisco, Calif.
Barde Steel Company, Seattle, Wash., and Portland, Ore.
Louisiana Supply Co., Sulphur and Brimstone, La.
Dunigan Tool and Supply Co., Main Office, Breckenridge, Tex. Branch stores, Willow Springs, Pampa, Turnertown and McCamey, Tex., and Hobbs, N. M.
Okmulgee Supply Corporation, Okmulgee, Okla.
Oil Field Equipment Co., San Antonio, Texas.

CHESTER

STEEL CASING AND LINE PIPE

Lubricated



Left—These connections are on a casinghead gasoline (compressor-type) plant in West Texas

Below—Discharge lines on compressors of refinery vapor-recovery plant equipped with semi-steel plug valves

THE lubricated valve has introduced an entirely new principle in the control of fluid flow in pipe lines. Previously, the generally accepted view regarding valves or pipe line stops was that leakage either through the line or through the stuffing box was inevitable and simply one of the afflictions to which all valves were subject. Also, most conventional nonlubricated valves when first installed as new valves gave a fairly good account of themselves, but this period of satisfaction is extremely short-lived at best and as soon as corrosion, erosion, normal wear and pipe line strains begin to get in their work, the story resolves itself into the same old circle of leakage, repairs, loss of production, high maintenance costs, etc., not to mention the ever-present hazard of fire and explosion with its attendant losses of life, limb, and property.

Even valves that are used principally for throttling purposes are at some time or another required to serve as a line stop or complete shut-off, and there is always present the necessity of preventing stuffing-box leakage to the atmosphere.

To the practical oil refiner there is no need to dwell upon the hazards of leakage as he is only too well aware of the dangers and the penalties that may result from a leaky pipe joint or stuffing-box. Likewise he knows the extreme importance of having at all times complete control of the flow in the various pipe lines in his refinery. A refractory valve, on which he must depend in the event of an emergency, that cannot be operated in time of need, is as good as no valve at all; and no one knows better than the refiner just how much may depend upon his being able to shut off quickly and surely the flow of oil or gas in an emergency.

Aside from the natural fire hazards present in any refinery, the routine problems of production demand absolutely reliable means for controlling the flow of oil or gas through the multitude of pipe lines that constitute the very fabric of a modern refinery. Of what use is it to expend large sums for producing high quality products to meet stringent specifications as to color, gravity, clarity, and distillation range, if, while handling in the network of pipes, leaky valves allow contamination and consequent spoilage of the product? It therefore behooves the refiner to protect himself against the contamination of his products, at least so far as equipment goes, by availing himself of the most modern and up-to-date developments in equipment among which the valves play an exceedingly important part.

That the lubricated plug cock in its present highly developed state offers a satisfactory solution of most refinery value problems is shown in its widely increased and rapidly growing use. In achieving this improved valve service the lubricated plug cock makes use of several inherent advantages peculiar to this form of line stop.

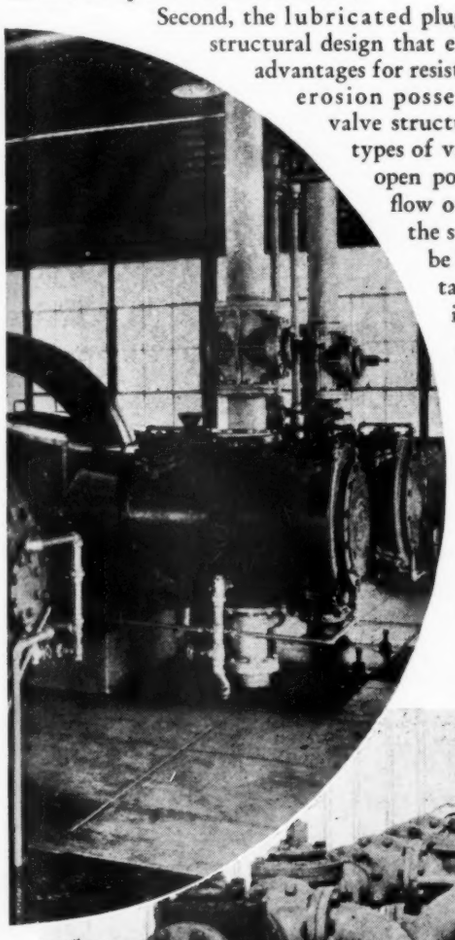
First, the lubricant used not only lubricates the working surfaces, but performs the exceedingly important function of sealing the contact surfaces against leakage of line fluid, not only when the valve is new and in good condition, but after long use when corrosion and erosion have played their part in destroying the original, carefully-machined metal surfaces. The lubricant or sealing medium can be frequently renewed

Plug Valves in Refinery Service

By G. F. SCHERER

Director of Research, Merco Nordstrom Valve Company

and, if desirable, can be increased in viscosity better to seal the interior worn valve surfaces. In this respect the principle of lubricant sealing is the same as that employed in sealing the pistons of an automobile engine with lubricating oil to prevent leakage of gas past the piston rings as well as lubricating the sliding metal surfaces. There is also the analogy provided by the use of a high viscosity oil in making up for wear after long use. It is to be understood, of course, that suitable lubricants are provided by the valve manufacturers that successfully resist the solvent action of the line fluid and the temperatures encountered.



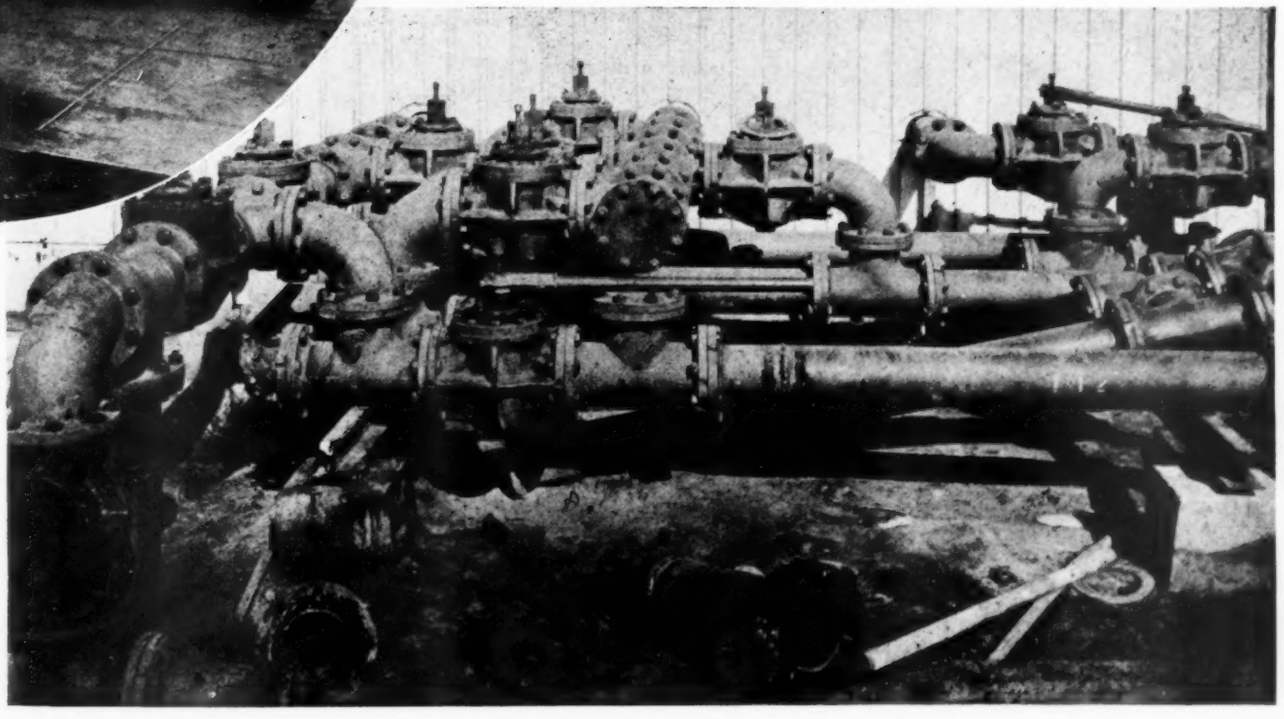
Second, the lubricated plug cock provides a structural design that embodies natural advantages for resisting corrosion and erosion possessed by no other valve structure. Conventional types of valves, when in the open position, permit the flow of line fluid over the surfaces that must be brought into contact when the valve is in the closed position, thus exposing these surfaces to possible corrosion and erosion produced by the flow of line fluid over them. The plug cock structure, when the valve is in the open position, presents no surfaces to the direct flow of line fluid and thus inherently provides a design that resists the wear and tear caused by the line fluid. In this structure the sealing surfaces are only momentarily and partially exposed when turning from open to closed position, or vice versa, and are protected when the valve is in the closed position.

With an impervious lubricant to seal off penetration of the line fluid between the machined parts, this form of valve possesses definite advantages for resisting corrosion. At the same time, by incorporating the principle of a hydraulic jack and using the lubricant under pressure to lift hydraulically the tapered plug free from its seat, complete provision is made for freeing the plug in case of possible sticking.

Third, the lubricated plug cock design lends itself admirably to quick operation, as a complete shut-off may be obtained with a 90-deg. or quarter turn operation. If a more gradual time of shut-off is desired in order to prevent water hammer in the pipe, this can be obtained by equipping the plug cock for operation by either spur or worm gear. Furthermore, in cases where a two-way or three-way valve is desirable these multiport types are also well adapted to the lubricant-sealing principle.

Fourth, the lubricated plug cock is quite practical in large sizes, many being in service that are 16 in., 20 in., 24 in., and even 30 in. in size. It is not generally known that plug cocks are available in these large sizes, which are thoroughly practical from an operating standpoint and offer the other natural advantages of plug cock design.

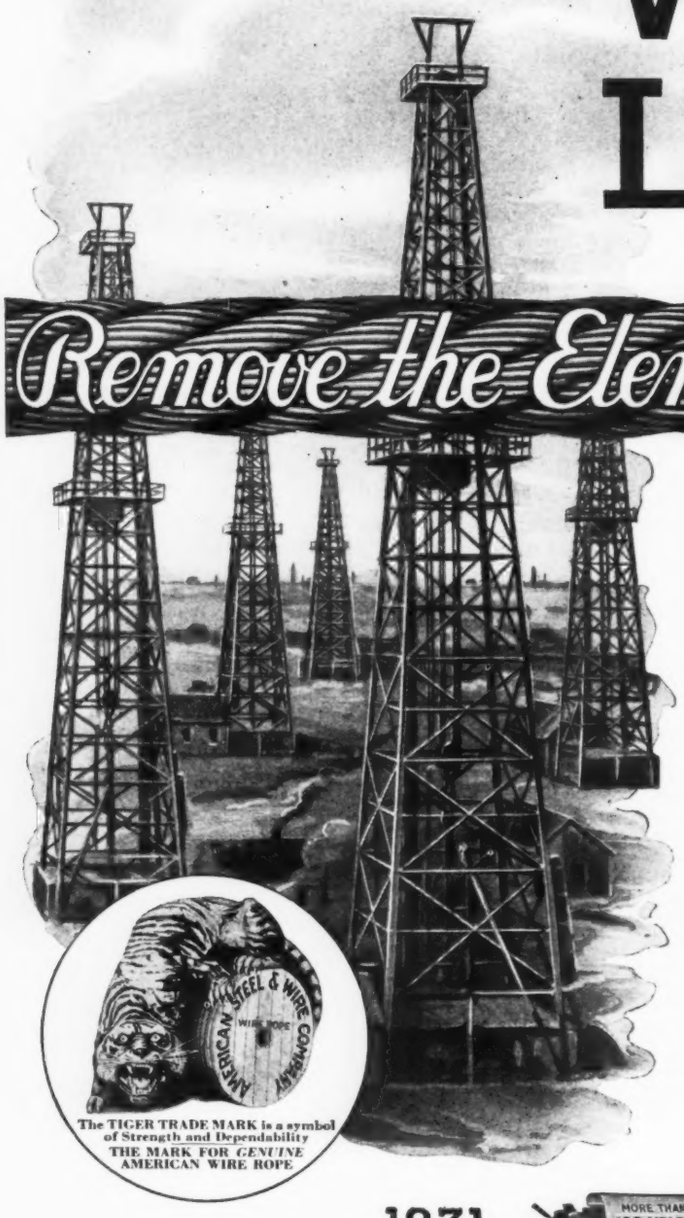
Below—Light oil manifold in a West Texas refinery



AMERICAN STEEL & WIRE COMPANY

WIRE LINES

Remove the Element of Chance



The TIGER TRADE MARK is a symbol of Strength and Dependability
THE MARK FOR *GENUINE* AMERICAN WIRE ROPE

WIRE Lines take such an important part in drilling that operators throughout the oil fields are playing safe by using **American Steel and Wire Company Wire Lines.** Wherever the going is tough—and the need for exceptional dependability exists—**American Steel & Wire Company Wire Lines** will establish remarkable records for their users. How much safer it is to use Wire Lines that have proved their dependability and stamina beyond question. Our special Wire Lines for Rotary and Cable Tool Drilling are made to remove doubt and worry from your mind. Convenient stocks and our nearby engineers are both at your immediate call.

1831 MORE THAN 100 YEARS of PROGRESS IN WIRE MAKING 1934

AMERICAN STEEL & WIRE COMPANY

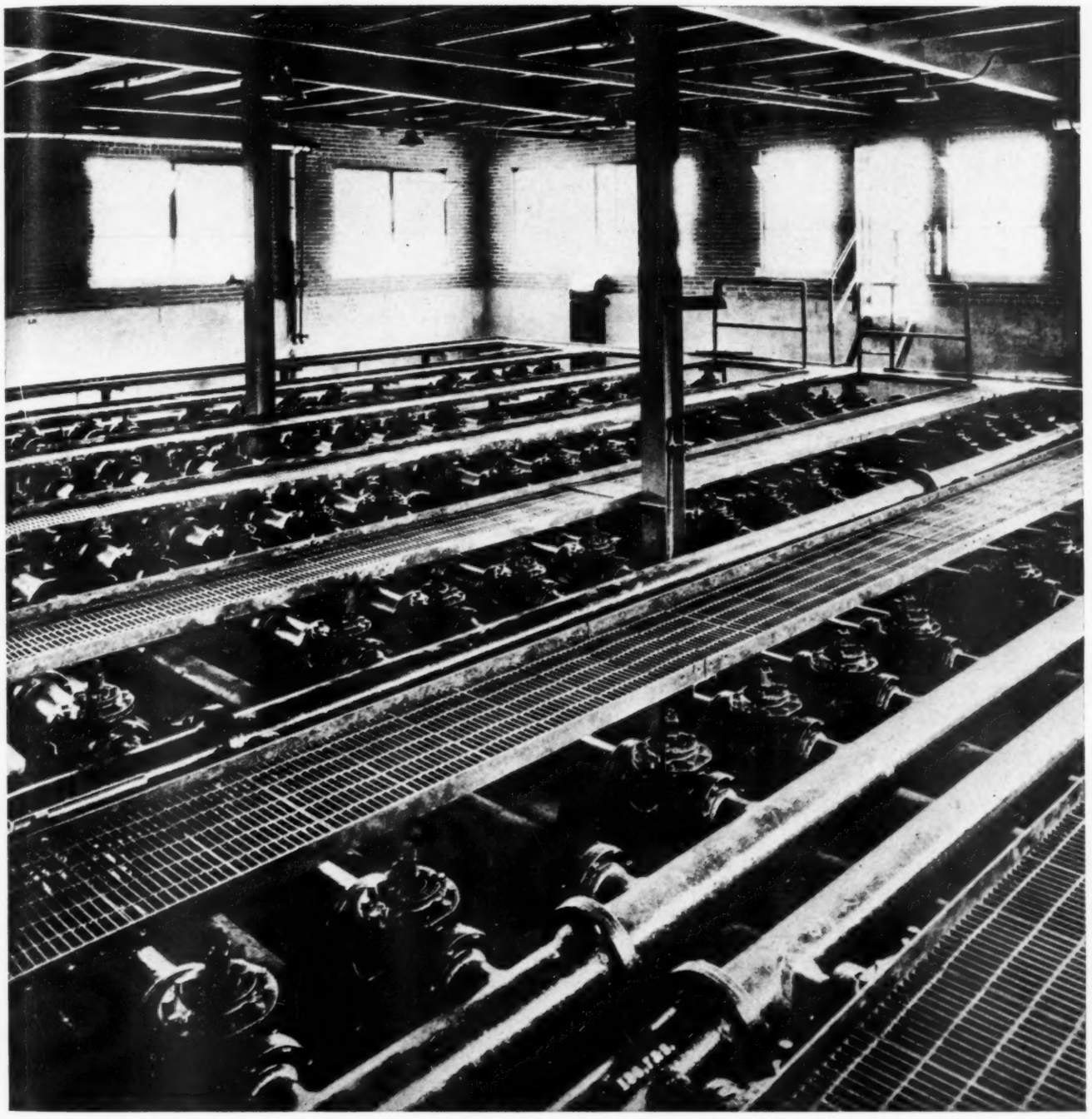
208 South La Salle Street, Chicago
94 Grove Street, Worcester

SUBSIDIARY OF UNITED STATES STEEL CORPORATION
AND ALL PRINCIPAL CITIES

Empire State Building, New York
First National Bank Building, Baltimore

Pacific Coast Distributors: Columbia Steel Company, Russ Bldg., San Francisco

Export Distributors: United States Steel Products Company, New York



Light oil manifold in a Mid-Continent refinery

Turning to the specific installations in the refinery where lubricated plug cocks are finding useful application, we note particularly the following:

1. Crude receiving and storage facilities.
2. The naphtha treating plant.
3. Transfer lines.
4. Pump manifolds.
5. Tail house distribution lines.
6. Lube oil treating plant and grease manufacture.
7. Cracking equipment.
8. Vapor recovery system.
9. Dewaxing equipment.
10. Fire protection lines.
11. Loading racks.
12. By-product specialties such as butyl alcohol, bottle gas, tetra-ethyl mixing, etc.

While not all types of crude oil present handling problems, we find numerous cases where, due to the sour nature of the crudes, the equipment for handling and storage of these crudes is subject to considerable corrosion. It is frequently necessary to treat these with chemicals in some way to reduce the corrosion before storage or before subjecting them to high temperatures in the more expensive still equipment.

The plug cock has always been a favorite among chemical manufacturers for resisting corrosion and we find the same to be true among refiners when faced with the problem of handling chemicals in the refinery. Likewise in the treating of naphthas either in batch or continuous treaters, the reliability, simplicity and quick operation of the lubricated plug cock is finding great favor for the handling and storage of sulphuric acid, caustic soda, "Doctor" solution, etc. The standard all-iron or cast-steel cocks are used generally, with bronzes or special alloys where their use is indicated for weak acid or high temperature conditions.

One of the commonest applications of lubricated plug cocks is that of agitator draw-offs where the valve is subject to strong and weak sulphuric acid, sludge acid, alkali, water and naphthas. For this purpose the plug cock is generally made of a nickel bronze alloy, but is also used when of cast iron. The strong-acid feed-line valves are of cast iron as well as those handling the caustic alkali. The pump manifold valves subject to hot sludge acid of about 35 deg. Baumé are of special bronze as well as those on the "peanut" dilution tank. On the continuous treaters the circulating lines and separators, the valves for handling strong acid and caustic are of all-iron while the sludge acid and weak acid are generally handled with bronze valves. When oleum or a fortified recovery acid are used cast-steel lubricated valves are frequently used. On account of the variety of chemical conditions present, the proper valve lubricants, as recommended by the manufacturers, must be used to obtain satisfactory service.

The principal valve problems connected with the transferring and pumping of the various naphthas and other distillates from one part of the refinery to another are the prevention of leakage, both internal and external. Internal leakage results in contamination of one product with another, sometimes to the extent of complete rejection, and external leakage results in increasing the fire hazard besides the actual loss of material involved. In both cases the lubricated plug cock has no superiors, the sealing plastic lubricant acting to prevent both internal and external leakage. There are no exposed seats to fill up with pipe scale, paraffin or sulphur and incipent corrosion is nullified by the plastic lubricant seal. The compactness and quarter turn operation makes the plug cock especially desirable for manifold work, permitting the concentration of a great number of controls within a small building or control pit. Another advantage is the ready visibility of the indicators showing whether the valve is open or shut. Common practice is to mount the plug cocks in the vertical position in the manifolds under an open grating or footwalk and operate them by means of tee-head wrenches, which can be left on if desired.

The manufacture and treatment of lubricating oils is receiving a great deal of attention these days. Modern automobile engines with higher compression ratios and higher speeds have accelerated the demand for better grade lube oils and this, coupled with the limited supply of paraffin base crudes, has resulted in a multitude of special methods based principally on selective solvent treatments. Many of these involve high pressures and corrosive materials making the use of plug cocks practically mandatory. Liquid sulphurdioxide, phenol, cresylic acid, nitro benzene, furfural, crotonaldehyde, are some of the chemicals used in selective solvent extraction treatment of lube oil that indicate the range of conditions encountered.

The use of lubricated plug cocks on cracking equipment is limited to those services where the temperatures are not above 500 deg. fahr., on account of the lubricant used in the valves, but in some of the newer installations where continuous cracking and fractionating are accomplished, many are used. These are principally on the fractionating towers, fuel lines and heat exchangers where the temperature of the oil or vapor is within the above limit.

One of the largest fields for use of lubricated plug cocks is in connection with the vapor recovery systems where the amount of naphtha vapor produced justifies such an installation. This is also the case with casinghead gasoline plants where large quantities of gas must be handled at high pressure and the liquid products recovered are of a highly volatile nature. Leakage is extremely important in these plants and the large numbers of lubricated plug cocks used in this service is the best evidence of their worth in holding tight against high gas pressures and volatile hydrocarbon liquids. They are found on the gas scrubbers, compressor manifolds, heat exchangers, stablizers, bubble towers and many other units. The lubricated plug cocks are particularly useful where the vapors being treated contain large amounts of hydrogen sulphide, both on account of its corrosive action and the tendency to cause hard deposits of sulphur in the valves and pipe lines. The lubricated plug cock will continue to function satisfactorily and give a tight shut-off even when the interior passages are nearly choked off with hard deposits of sulphur. The same is true when they are subjected to vapors carrying suspended pitchy or paraffinic matter that tends to deposit in the form of a hard interior coating in the lines.

The removal of wax from lubricating oils always introduces the problem of keeping the lines and valves free of deposited paraffin. Because of the natural structural advantages of plug cocks, which have no seats to fill up with solid materials, they are particularly adapted to handling fluids that carry solid matter in suspension. Both in the newer type of dewaxing equipment operating at extremely low temperatures and in the older plants, many lubricated plug cocks are to be found.

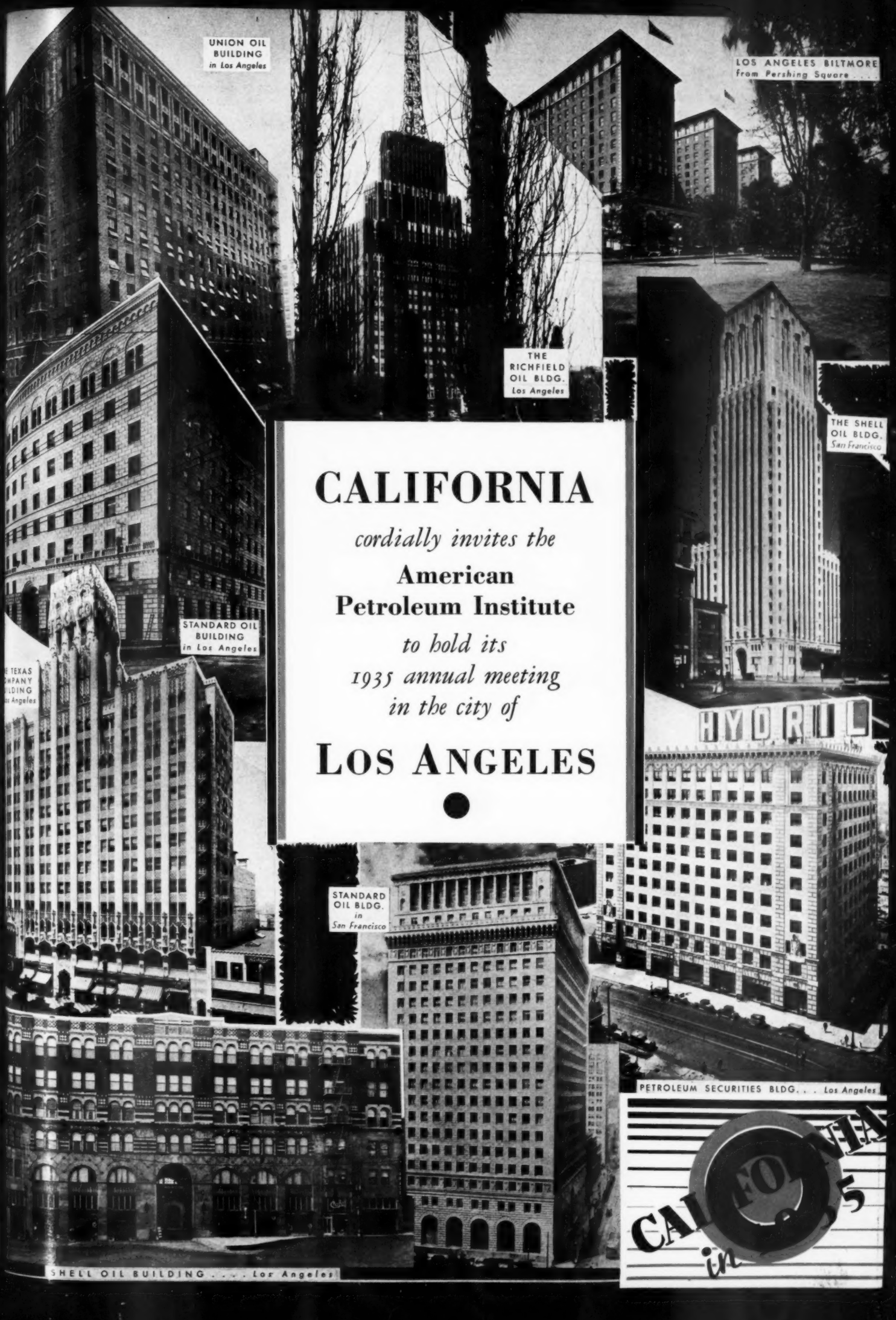
Most loading racks are of necessity in locations where the valves are exposed to all kinds of weather. It is therefore most important to equip these racks with valves that lend themselves to easy operation and freedom from leaks with a minimum of attention. The use of lubricated plug cocks on loading racks offer the advantages of quick opening and closing and freedom from leakage, particularly in handling light naphthas and distillates. They occupy but little space and can be easily equipped with locking devices where that feature is desired. A little attention to lubrication now and then will keep them in good operating condition and free from leakage.

Only a few refineries include plants for the manufacture of the various chemical specialties derived from petroleum. However, the manufacture of chemicals is a field where plug cocks have been used for many years, and the modern lubricated plug cocks show to advantage in this phase of petroleum refining as well, evidence of which is the large numbers in use in these by-product plants.

In connection with the use of lubricated plug cocks in refinery service it might not be out of order to mention a few facts regarding their efficient maintenance. First, since so much depends upon the lubricant it goes without saying that the valves should be kept well lubricated with the proper kind of lubricant. Various lubricants are available as recommended by the manufacturers, and it should be remembered that plug cock lubrication is a field in itself and that much depends upon the use of a valve lubricant, which is especially made for the conditions of service in which the valve is being used. Owing to the slow rate of rotation of the plug and high bearing pressure present, a special lubrication problem is involved; besides, the lubricant must be resistant to the action of the line fluid being handled. The pressure developed by the lubricant screw or grease gun is sufficient to handle lubricant of high viscosity and therefore high sealing qualities. Also a high degree of stickiness is desirable to prevent rupture of the lubricant film between the metal surfaces.

Attention should be paid to keeping the gland bolts pulled down sufficiently tight or in whatever adjustment is used to hold the tapered plug on its seat. Separation of the contact surfaces without the simultaneous filling of this space with lubricant will result in accumulation of line fluid in this space, with corrosion or sedimentation likely to follow.

If the valves have been in service a long time attention should be paid to the condition of the packing; it may be necessary to renew this at long intervals. To obtain the longest life, care should be exercised to have the cocks fully open or shut so that the port of the plug registers exactly with that of the body when in the open position, otherwise the lips will be subjected to erosion by the line fluid.


UNION OIL BUILDING in Los Angeles
LOS ANGELES BILTMORE from Pershing Square . . .
THE RICHFIELD OIL BLDG. Los Angeles
THE SHELL OIL BLDG. San Francisco
CALIFORNIA
cordially invites the
American Petroleum Institute
to hold its 1935 annual meeting in the city of
LOS ANGELES
STANDARD OIL BUILDING in Los Angeles
HYDRIL
STANDARD OIL BLDG. in San Francisco
PETROLEUM SECURITIES BLDG. . . Los Angeles
SHELL OIL BUILDING . . . . Los Angeles

OFFICERS
CALIFORNIA OIL *and* GAS ASSOCIATION

C. S. Jones, *President*
Executive Vice-President, Rio Grande Oil Company

R. B. Lloyd, *Vice-President*
President, The Lloyd Corporation

California Oil and Gas Association

ESTABLISHED 1906

OFFICERS

C. S. JONES — PRESIDENT
RALPH B. LLOYD — VICE-PRES.
L. P. ST. CLAIR — VICE-PRES.
H. L. WESTBROOK — TREASURER
D. S. KILGOUR — ASST SECRETARY

510 WEST SIXTH STREET

LOS ANGELES, CALIFORNIA

DIRECTORS

R. A. BROOKFIELD — W. C. McDUFFIE
R. E. COLLOM — ALEXANDER S. MACBETH
J. A. CRAWFORD — A. C. MATTEI
O. S. FAULKNER — T. B. MOSHER
E. B. GILMORE — C. E. OLMSTED
WM. P. HUMPHREY — W. B. PYRON
C. S. JONES — WILLIAM REINHARDT
K. R. KINGSBURY — F. C. RIPLEY
G. LEGH-JONES — L. P. ST. CLAIR
RALPH B. LLOYD — A. L. WEIL
H. L. WESTBROOK

Directors of the American Petroleum Institute

Gentlemen:

The California Oil and Gas Association extends a cordial invitation to the American Petroleum Institute to hold its 1935 annual meeting in Los Angeles.

This invitation is prompted by a number of factors mutually attractive to your organization and to the California oil fraternity. A large and active group of the Institute's membership resides in California. These men have had an important part in the steady advancement made by the petroleum industry of California since the 1925 convention was held here. Executive and field problems incident to this advancement have elicited interest in other parts of the oil world, and a desire has been created to study them. Opportunity for such study can best be afforded by bringing the Institute meeting to Los Angeles in 1935. Many California fields of importance are within an hour's travel of that city over paved highways, and a short time only is required for observation of a variety of unusual field conditions such as deep drilling, handling of enormous pressures, and methods of pumping de-p wells.

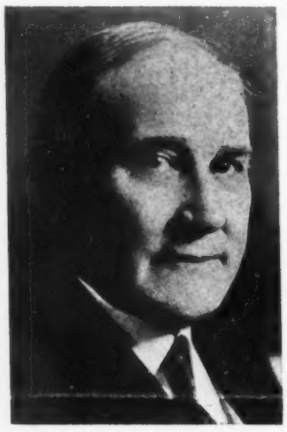
Travel accommodations between California and other oil centers are excellent. Our state can now be reached almost as quickly and economically as any other prospective meeting place. Los Angeles hotel accommodations are more than adequate, and scenic attractions, climatic conditions, and entertainment facilities are renowned.

The California oil industry, the most important in the state, will consider the acceptance of this invitation an honor.

Yours very truly,

Chas S Jones

President.

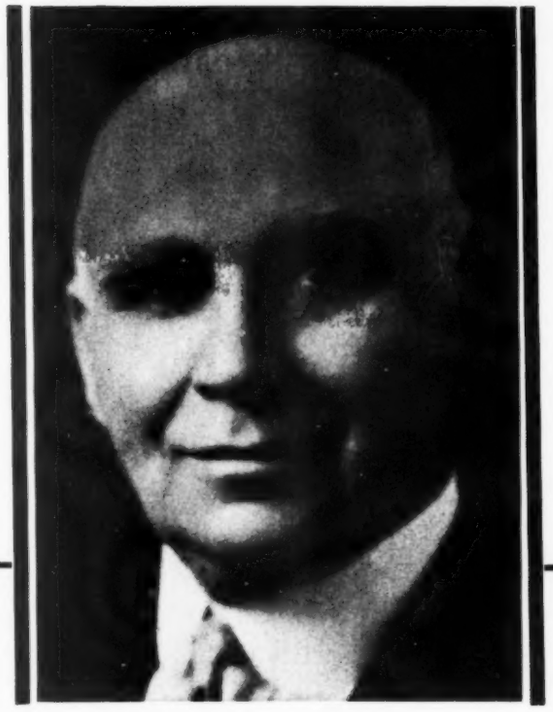


L. P. St. Clair, *Vice-President*
President, Union Oil Company of California

A. L. Weil
Member Executive Committee
President, General Petroleum Corporation of California

H. L. Westbrook, *Treasurer*
Vice-President, Belridge Oil Company

D. S. Kilgour
Assistant Secretary



FRANK F. MERRIAM
Governor of the State of California

FRANK F. MERRIAM
GOVERNOR

State of California
GOVERNOR'S OFFICE
SACRAMENTO

October 6, 1934

To the President and Delegates of the
American Petroleum Institute
In Convention Assembled
Dallas, Texas

Greeting:-

As Governor of California, I am happy to extend to the members of the American Petroleum Institute a cordial invitation to hold their 1935 convention in California.

California has much to offer as a convention State, particularly climate, hotel accommodations, spacious auditoriums, and places of scenic interest.

Wishing the Dallas convention much success, and awaiting the opportunity to personally welcome the members to California in 1935, I am

Very sincerely yours,

Frank F. Merriam

GOVERNOR OF CALIFORNIA

WE WANT YOU!

THE WILDCATS

Sing a Song of happiness — A bottle full of rye

Four and twenty Wildcats — 'neath California Sky

Waitin' for the day to come — in nineteen thirty-five

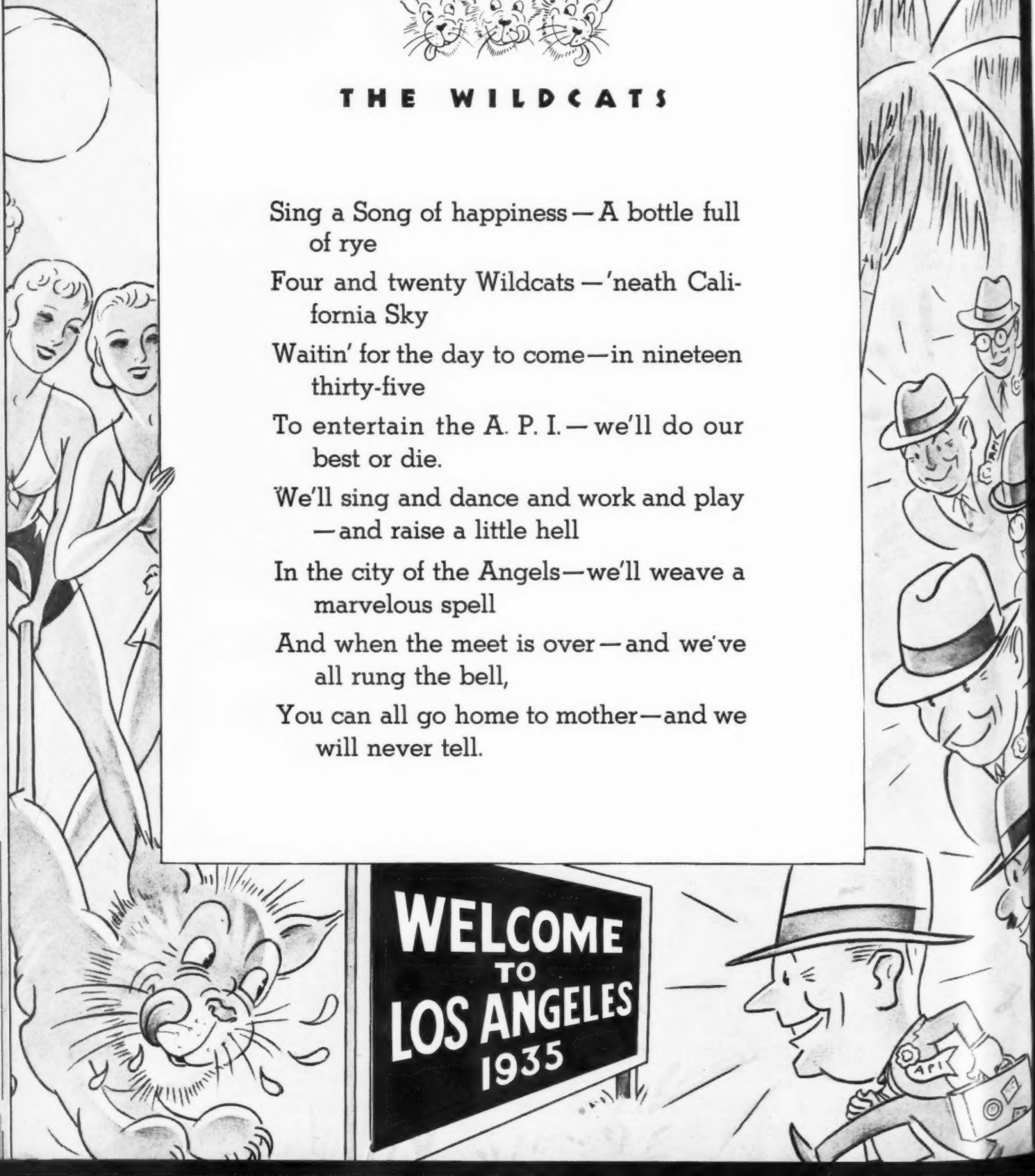
To entertain the A. P. I. — we'll do our best or die.

We'll sing and dance and work and play — and raise a little hell

In the city of the Angels — we'll weave a marvelous spell

And when the meet is over — and we've all rung the bell,

You can all go home to mother — and we will never tell.



WARD B. BLODGET
Oil Producer

J. A. DUNN
National Supply Co. of Calif

LOREN L. HILLMAN
Hillman-Long, Inc.

HARRY A. KASSEBAUM
General Petroleum Corp. of Calif.

TORREY H. WEBB
The Texas Company

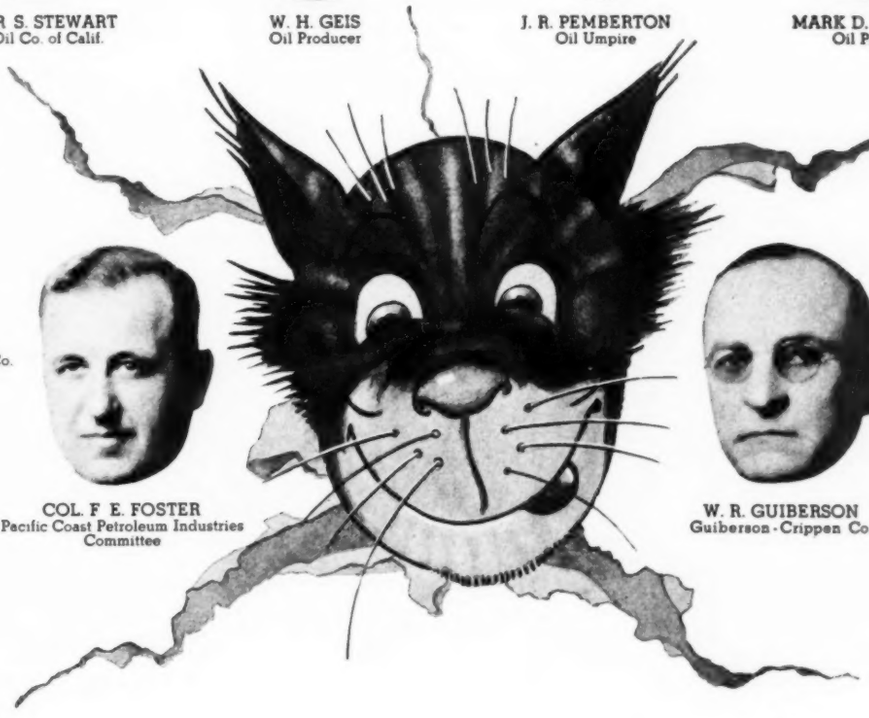
ARTHUR S. STEWART
Union Oil Co. of Calif.

W. H. GEIS
Oil Producer

J. R. PEMBERTON
Oil Umpire

MARK D. WOOLERY
Oil Producer

W. DALE RUSSELL
Youngstown Sheet and Tube Co.



COL. F. E. FOSTER
Pacific Coast Petroleum Industries Committee

W. R. GUIBERSON
Guiberson-Crippen Co.

JOSEPH JENSEN
Associated Oil Co.

CHARLES D. WAGNER
D & B Pump & Supply Co.

D. M. SMITH
Sovereign Oil Co.

A. E. WALLACE
Western Gulf Oil Co.

A. S. HAYES
Kettleman North Dome Assn.

DANA HOGAN
Hogan Petroleum Co.

FLOYD S. BRYANT
Standard Oil Company of Calif.

FRANK B. CHAMPION, JR.
Byron Jackson Company

D. S. KILGOUR
Calif. Oil and Gas Association

JOHN B. WINSTON, JR.
Los Angeles Police Commissioner

H. H. CLARK
National Supply Company of Calif.

FRANK A. MORGAN
Rio Grande Oil Co.

HARRY L. HARPER, *President*
Los Angeles County Chamber of Commerce

THE LOS ANGELES CHAMBER OF COMMERCE
OFFICE OF THE PRESIDENT

October 3, 1934.

To the Officers and members,
American Petroleum Institute,
In Convention Assembled,
Dallas, Texas.

Gentlemen:

The Los Angeles County Chamber of Commerce is happy to join with your local members in extending a most cordial invitation to the Institute to meet here next year.

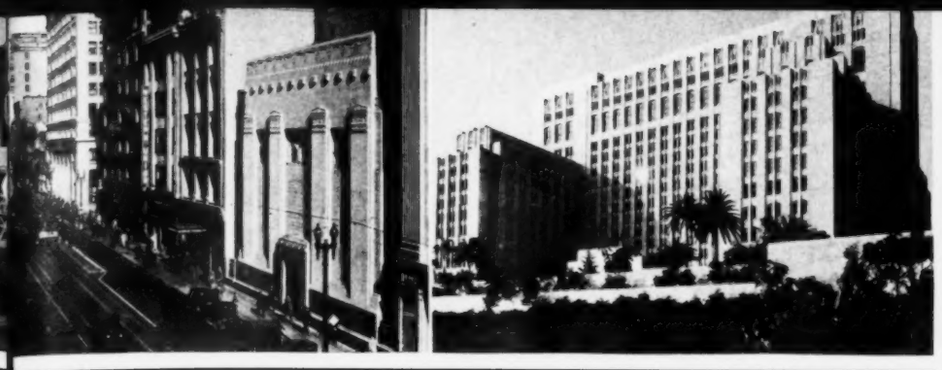
To those of your members who have been here before, a return trip will be "A Natural", while to others it will be the fulfillment of a long felt desire.

Coming one way and returning by others, makes it possible for delegates and friends to see the major part of the United States in a great swing about the country, and to enjoy the delightful climate of Southern California, its great Oil and Gas Industry, famous hotels and restaurants, Old Missions, Ocean Beaches, Orange Groves, Santa Catalina Island, Mt.Lowe, Huntington Library, Hollywood with its Motion Picture interests, the charm of adjacent cities, and the beautiful World's Fair in San Diego on the site of the 1915 International Pacific Exposition -- all of which will endow the trip with happy memories.

With best wishes for the success and enjoyment of your present convention and looking forward to your coming to Los Angeles in 1935, I am

Sincerely yours,

Harry L. Harper
President.



FRANK L. SHAW
Mayor of Los Angeles

FRANK L. SHAW
MAYOR

OFFICE OF THE MAYOR
CITY HALL
LOS ANGELES, CALIFORNIA

September 24, 1934

President and Delegates
American Petroleum Institute
In Convention Assembled
Dallas, Texas

Greetings:

As Mayor of Los Angeles, I wish to extend to you the most sincere invitation of our City to honor us with the convention of your association in 1935.

Los Angeles will look forward with anticipation to welcoming and entertaining you next year, should our city have the good fortune of receiving a favorable vote on this invitation.

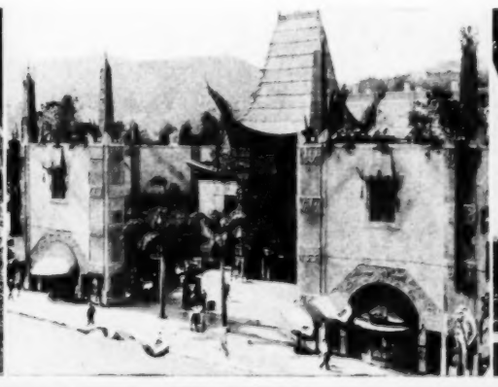
The advantages of Los Angeles as a convention city are too well known to justify lengthy comment here, but I do want to assure you that if your next annual conclave is awarded to this city, we shall contribute every possible effort toward making it one of the most successful and outstanding events in the history of your organization.

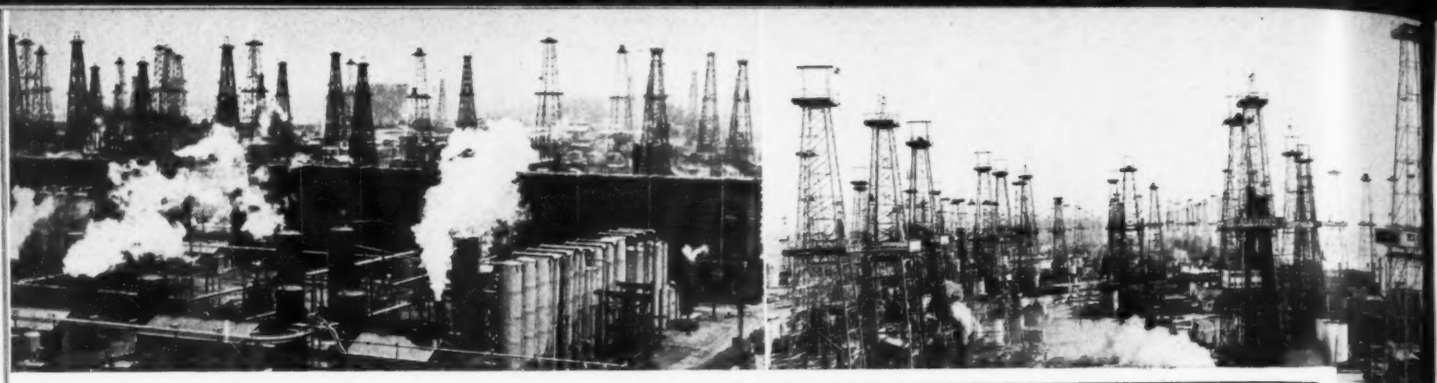
With best wishes for the success of your present convention and kindest personal regards, I am

Very sincerely yours,

Frank L. Shaw
MAYOR

FLS:R





GOVERNING MEMBERS PACIFIC DIVISION

F. C. Merritt, *Chairman*
President, Elliott Core Drilling Company

E. S. Dulin
President, Byron-Jackson Co.

THE AMERICAN PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

324 Higgins Building
108 West Second Street
LOS ANGELES, CALIFORNIA

October 13, 1934

DIRECTORS OF THE AMERICAN PETROLEUM INSTITUTE,
250 Park Avenue,
New York, New York.

Gentlemen:

The American Petroleum Equipment and Suppliers' Association, Pacific Division, extends a most cordial invitation to the American Petroleum Institute to hold its 1935 meeting in Los Angeles.

California has contributed much to the advancement of the oil industry, and the holding of your 1935 meeting in California will afford your members an opportunity of studying and observing deep-well drilling and producing methods. Many of the largest oil tool and machinery manufacturing plants are located in California.

Modern transportation facilities are such that travel time to California from other states has been materially reduced. Our hotels are of the best with ample accommodations. California climate, scenery, and entertainment are known throughout the world.

We will consider it an honor if you accept this invitation.

Cordially yours,

President

D. S. Faulkner
Vice-President, National Supply Company of California

L. H. Keim
Vice-President, Oil Well Supply Company

J. A. Crawford
National President, American Petroleum Equipment Suppliers' Association; National Chairman of Code Authority.
President Republic Supply Co. of California

E. W. Goeser
Vice-President, Emsco Derrick and Equipment Company

H. F. Emme
Supervisor Code Authority

H. A. Bardeen
Director and Member Executive Committee
President, Bardeen Petroleum Corporation

William H. Geis
Director and Member Executive Committee
President, Arrowhead Oil Company

Rush M. Blodget
Vice-President and General Manager
Director and Member Executive Committee

R. A. Broomfield
Vice-President and Director
Member Executive Committee
President, Barnsdall Oil Company

Ralph B. Lloyd
President and Director
Member Executive Committee
President, Lloyd Corporation

Jack J. Doyle
Vice-President and Director
Member Executive Committee
President, Doyle Petroleum Corp

C. C. Spicer
Secretary-Treasurer and Directo
Member Executive Committee
President, Republic Petroleum Company, *Ltd.*

OIL PRODUCERS SALES AGENCY
OF CALIFORNIA

To the
Officers and Members,
American Petroleum Institute,
New York City, N.Y.

Greetings:

CALIFORNIA invites you to hold your next Annual Meeting within its boundaries, at the end of the pioneers' trail, at the entrance of the water-ways that will provide the next development era for the West.

For the serious business to which you must attend Los Angeles has demonstrated its ability with past conventions to provide the necessary facilities. They are here for your use.

For the entertainment of yourselves, members of your family, and your guests - the playground of the Pacific Coast awaits you.

Oil Producers Sales Agency of California, with over two hundred independent oil producers in its membership, joins other organizations in this state-wide invitation.

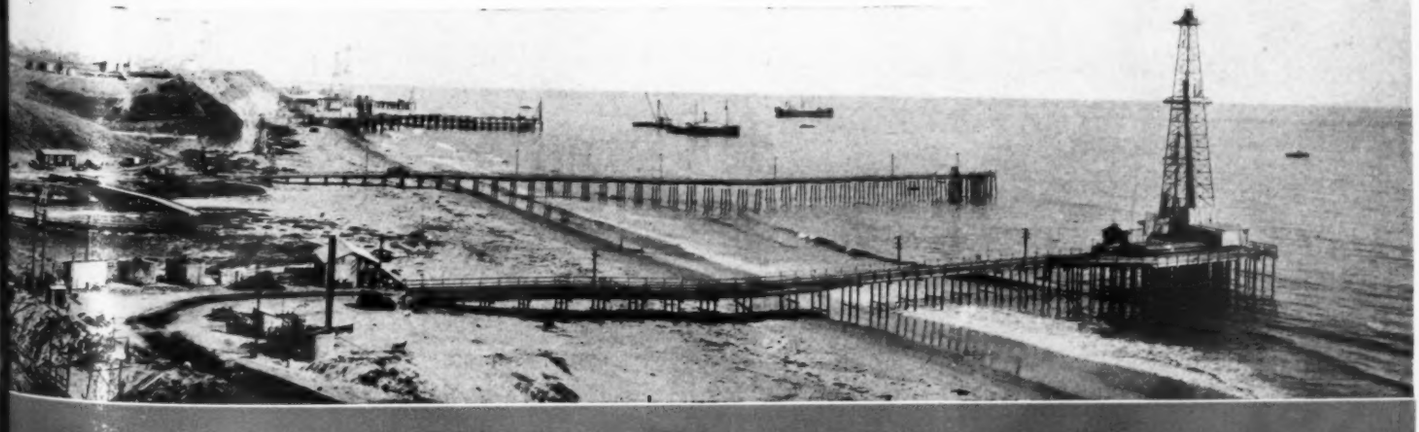
By order of the Board of Directors,

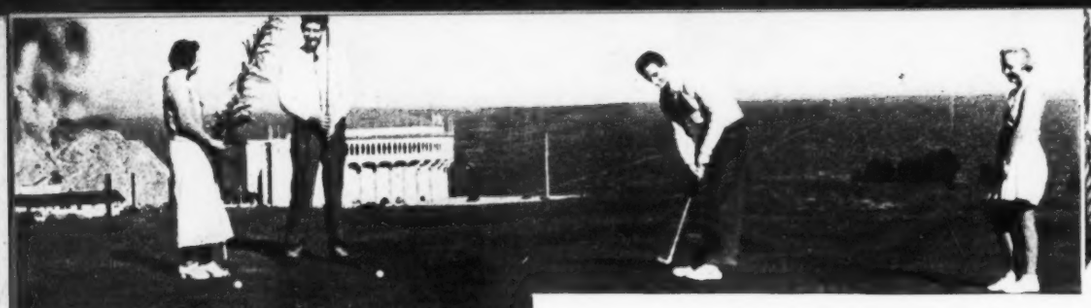
OIL PRODUCERS SALES AGENCY OF CALIFORNIA,

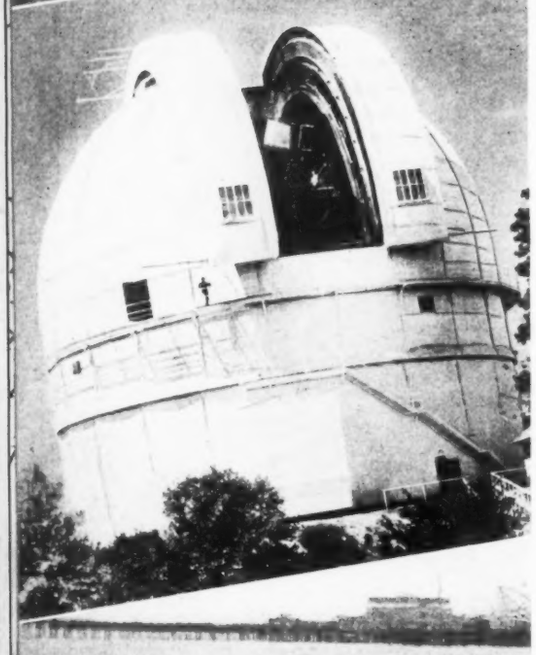
Rush M. Blodget

Vice-President and General Manager.

September 28, 1934.







County of Los Angeles

Board of Supervisors

Los Angeles

October 11, 1934.

JOHN R. QUINN
SUPERVISOR FOURTH DISTRICT

MEMBERS OF BOARD
JOHN R. QUINN
CHAIRMAN
HUGH A. THATCHER
GORDON L. MCDONOUGH
HARRY M. BAUM
ROGER JESSUP

Officers and Members of the
American Petroleum Institute
In Convention Assembled,
Dallas, Texas.

Gentlemen:

Los Angeles county, the center of one of the world's major oil producing areas, has the great honor of extending through us, its Board of Supervisors, a most cordial invitation to the American Petroleum Institute to hold its National Convention for 1935 in our community.

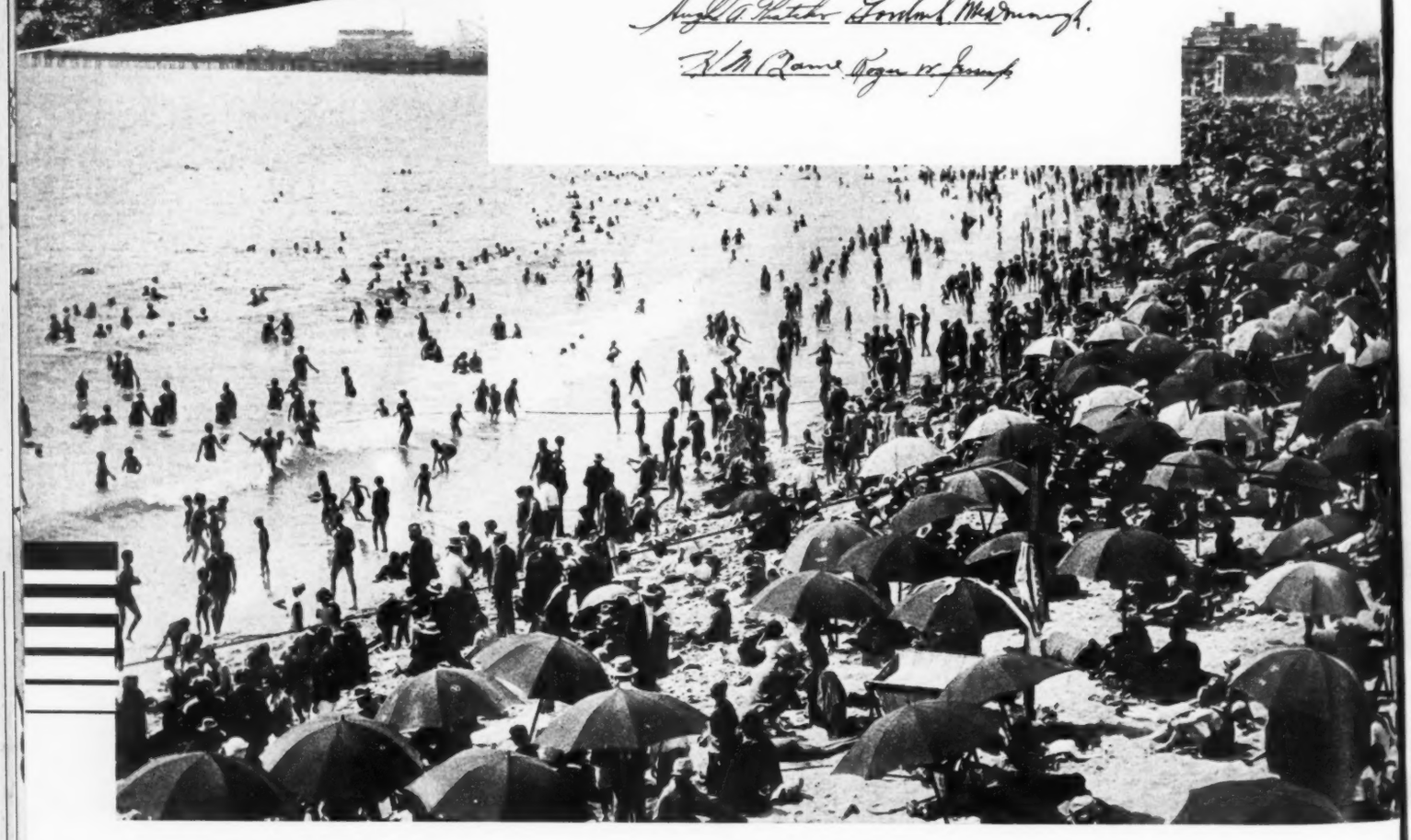
With the proverbially warm hospitality of Southern California, the public officials and citizenry of our county are eager to serve as hosts in extending a welcome to your officers and delegates.

Accommodations for your important business sessions, as well as for housing your officers and delegates, are unsurpassed. Equally unsurpassed are the facilities for entertainment and relaxation in our beautiful country.

With our highest expressions of regard, we are

Very sincerely yours,

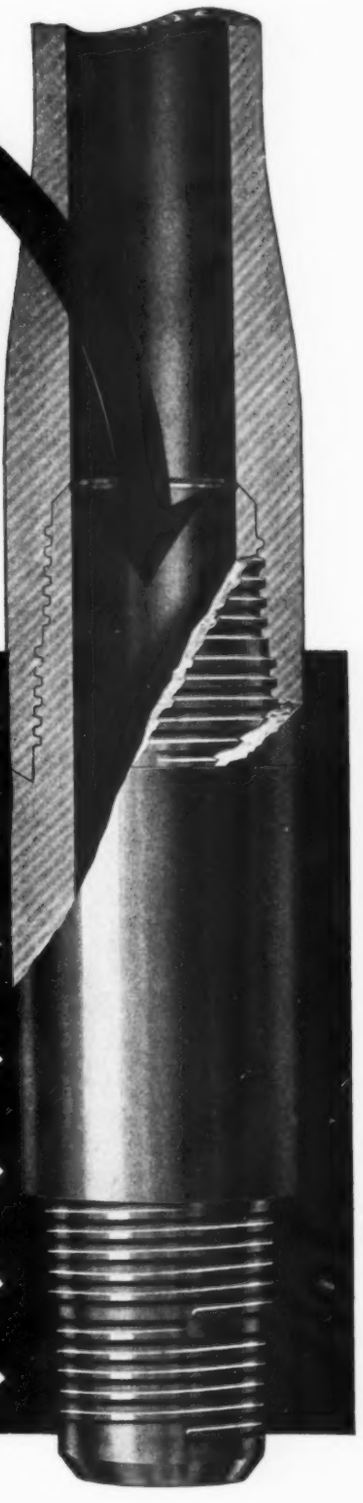
John R. Quinn
Hugh A. Thatcher Gordon L. McDonough
Harry M. Baum Roger Jessup



The BIGGEST Thing in Drill Pipe—

THE
HOLE
THROUGH
HYDRIL
INTERNAL FLUSH DRILL PIPE JOINT

Is the same size as the Full Inside Diameter of the Pipe



When we say the *Biggest* thing in Drill Pipe, we mean just that . . . for the area of the circulation passage is the maximum obtainable in each size pipe from 2⅜ inch on up. Here is the way they compare:

All dimensions in inches

Pipe Size, Weight & I.D.	Upset A.P.I. Drill Pipe		A.P.I. Full Hole Tool Joint		HYDRIL Internal Flush Tool Joint	
	I.D. of Upset	Area	I.D.	Area	I.D.	Area
2⅜ 6.65 lbs. 1.815 I.D.	1⅛	.9940			1¾	2.405
2⅞ 10.4 lbs. 2.151 I.D.	1-3/16	1.108			2⅛	3.547
3½ 13.3 lbs. 2.764 I.D.	1⅞	2.761	2-7/16	4.666	2¼	5.940
4½ 16.6 lbs. 3.826 I.D.	2-13/16	6.213	3	7.069	3-13/16	11.416
5-9/16 22.2 lbs. 4.859 I.D.	3-13/16	11.416	4⅛	13.364	4-13/16	18.190
6⅝ 25.2 lbs. 5.965 I.D.	5	19.635	4-15/16	19.147	5-15/16	27.688

Note that the *diameter of the upset* in API pipe is the limiting factor that controls how much fluid may pass through the drill string. Hydril is not thus limited. All seamless drill pipe manufacturers make pipe for the Hydril Internal Flush Joint, *the biggest thing in drill pipe.*

- No internal upset
- More metal at joint
- O.D. close to A.P.I. standards
- Exclusive double step square thread
- Extra strength at shoulders
- Inside-the-pipe tools pass freely
- Made in all sizes

Patented
Other Pats. Pending

TRADE MARK HYDRIL

HYDRIL COMPANY
714 West Tenth Street, Los Angeles, California

Doheny Stone Drill Company, of Texas
4300 Calhoun Road, Houston, Texas

California

Is Logical Meeting Place for the American Petroleum Institute in 1935 › › › › › ›

THE AUTHOR

By

C. S. JONES

President,
California Oil and
Gas Association

CALIFORNIA, a state in which scores of major conventions are held annually, is eager to have the 1935 meeting of the American Petroleum Institute. Having extended its invitation through the California Oil and Gas Association and other organizations, the California oil fraternity in its several branches is hopeful of acceptance. The invitation carries with it the endorsement of the Governor of the State, the Mayor of Los Angeles, the Los Angeles and State Chambers of Commerce, and other civic officials and bodies. Such unanimity should in itself strongly influence the Institute's decision. But other reasons why California should be favored are numerous.

It has been the practice of the American Petroleum Institute, while frequently selecting Chicago as a central meeting place, to award the convention occasionally to a city in one or another of the oil-producing areas. Nine years have elapsed since the 1925 meeting, the only meeting of the Institute that has been held in California. That occasion is recalled as most successful from the standpoint of both instruction and entertainment. Now, because of this state's position as one of the Nation's three largest producers of crude oil and the fact that an imposing section of the Institute's membership lives and is active here, we feel justified in soliciting recognition as the convention state again in 1935.

Our solicitation is not without its provincial motives. We are aware of the distinction that would be conferred upon our state, and more directly, upon its petroleum industry. We are seeking also the manifold benefits that would accrue to many local oil men who find it impossible to attend regularly when the convention is held in remote states. But California has much to offer the A.P.I.

The men who comprise the oil fraternity here are among the most progressive to be found anywhere. Confronted with a wide variety of perplexing geological and economic conditions, they have displayed resourcefulness and initiative and have become recognized for both their inventiveness and the readiness with which they adopt the meritorious ideas of others. Thus California has come to be looked upon as something of a scientific and economic laboratory for the entire oil world.

It was here that extremely deep oil sands were first encountered. Coping with them resulted in the invention of many new drilling devices and the working out of special methods for their use. High rock pressures and the pumping of deep wells taxed the ingenuity of our engineers, but left them a fund of special technical knowledge well worth exchanging with that of men from other sections. And field conditions here are such as to merit first-hand study.

In all other branches of the industry California methods, men, and institutions exemplify efficiency. Because California is one of the leading states in point of total capacities, our refining plants are equipped with up-to-date processes and are operated in accordance with advanced methods. The same may be said of our gasoline manufacturing plants. At Santa Fe Springs will be found the largest casinghead plant in the world, and throughout the California fields are plants that embody the finest and most efficient in equipment and whose operators are among the best informed. Pipe line construction and operation have been developed here to a high degree of efficiency. Many revolutionary methods of pipelining, among them submarine line construction, have had their birth in California. Finally, every conceivable kind of marketing problem, it would seem, has arisen at one time or another on the Pacific Coast. But our marketing executives have been equal to each emergency; they, too, have ideas and experiences to exchange.

California executives are thoroughly familiar with the sundry aspects of such live economic problems as unitization and curtailment. In fact it was at Kettleman Hills that the first program for coöperative unit development based strictly on sub-surface conditions was worked out. So successful was the project that it remains today one of the most efficient where a group of companies is involved. It was in California that first experiments were made with a method of proration based on scientific information. Here the extent of curtailment is dependent among other things upon the gas-oil ratio, a distinct departure from arbitrary methods usually employed. So, as we have pointed out, members of the American Petroleum Institute will profit in a material way if, through holding the 1935 annual meeting in Los Angeles, they are given an opportunity to exchange ideas, experiences, and data with the oil men of our state.

The cost of traveling from most oil states to California is now fairly reasonable, and scarcely more time is consumed in the journey than would be required to go to Chicago. This state is also reached by plane from all parts of the United States and by water from foreign countries. Facilities for handling the convention need hardly be mentioned. Los Angeles is one of the foremost convention cities of the world; hotels are equipped to handle meetings of whatever size with minimum effort; entertainment possibilities include everything in the category; the climate is especially attractive in the fall.

California invites the oil industry.

Thoroughly Dependable

Elliott Cable Tool Core Drill

Elliott Model 34 Rotary Core Drill

The value of an oil well core depends on how clearly and accurately it shows the character and other important features of the stratum cored. The value of a core drill in turn is measured by the value of the cores it recovers.

Elliott Core Drills have built up a reputation for outstanding performance year after year through their ability to bring up exact samples of formations in their natural state, thereby giving precise and dependable knowledge of actual conditions in the hole; enabling intelligent, efficient and economical drilling procedure; and assuring maximum production from the well.

Each type of Elliott Core Drill excels in the recovery of well formed, informative cores of genuine value. That it is thoroughly dependable in this respect, at all times and under all conditions of service, is of tremendous importance to any producing company.

•

Illustrated Bulletins containing detailed description and engineering data on Elliott Core Drills will be supplied to any interested oil company on request. Please state whether rotary or cable tool methods are used.

ELLIOTT CORE DRILLING COMPANY

4731 East 52nd Drive, Los Angeles, California, U.S.A.

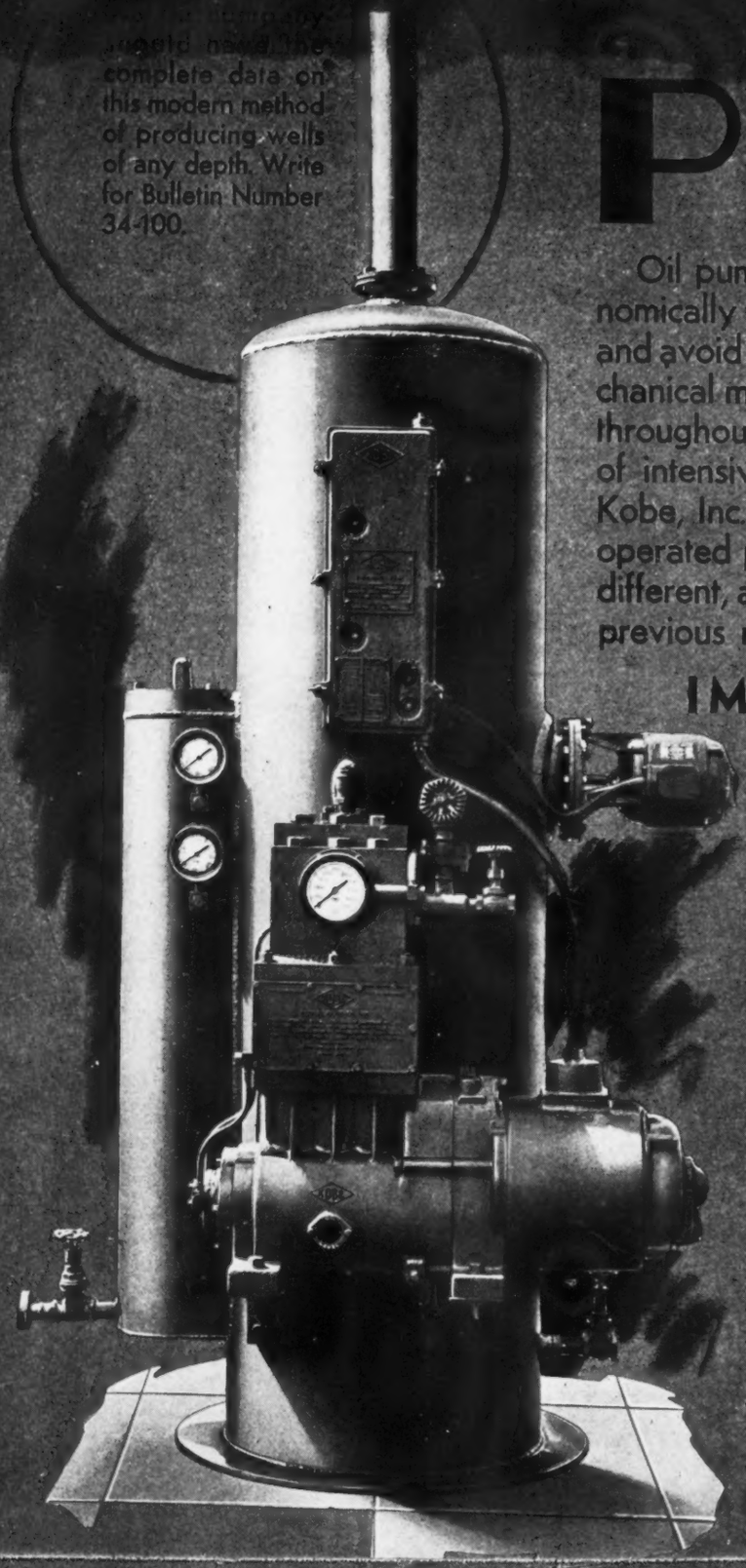
Export Office: 525 Graybar Bldg., New York City

Elliott CORE DRILLS

KOBE

HYDRAULIC DEEP WELL PUMP

Everybody should have the complete data on this modern method of producing wells of any depth. Write for Bulletin Number 34-100.



Oil pumping equipment that efficiently and economically will meet a wide range of well conditions and avoid the difficulties and expense inherent in mechanical methods, long has been a recognized need throughout the petroleum industry. After eight years of intensive development and experimental work Kobe, Inc. supplies this need with a complete fluid operated pumping unit that is entirely new, entirely different, and offers many distinct advantages over previous methods.

IMPORTANT FEATURES

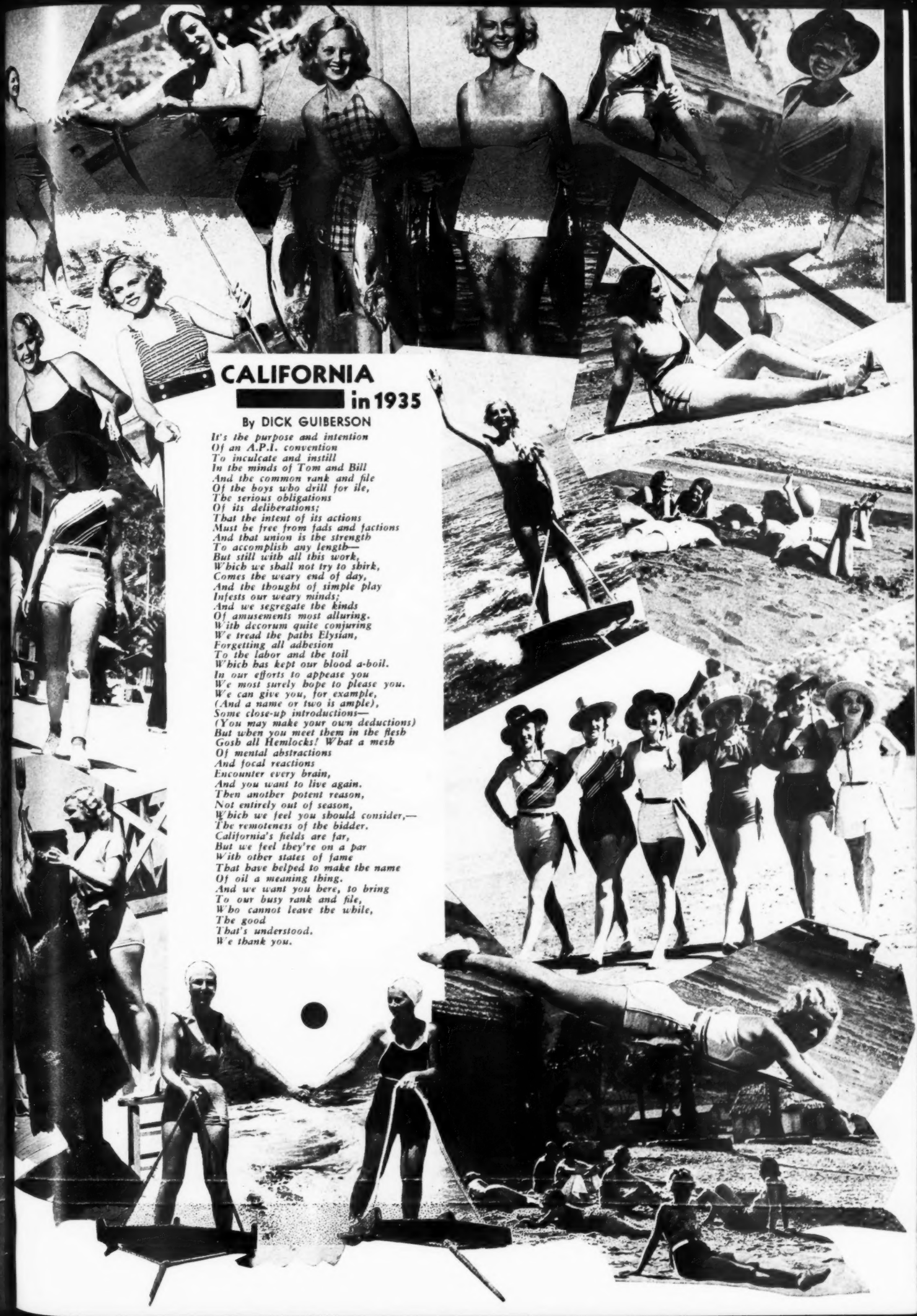
1. Provides power at the pump.
2. Stationary tubing replaces reciprocating sucker rods.
3. Eliminates massive surface equipment.
4. Automatic production control.
5. Operates efficiently in crooked wells.
6. Full salvage value if equipment is moved.
7. Over-all efficiencies of 50% to 75%.
8. Simple, efficient means of central plant operation.
9. Utmost in safety to operators.
10. Substantial reduction in power cost.
11. Lower maintenance cost.
12. Economical production of stripper wells.
13. Extends economical pumping to greater depths.
14. Gives dependable data on well conditions.
15. Eliminates wear of tubing and casing.
16. Provides a means of preventing wax deposit in tubing.
17. Adaptable to the pumping of oil of any gravity.
18. Does not emulsify production.

KOBE, INCORPORATED

(Pronounced KŌB)

Manufacturers of KOBE Heat-Treated Screen Casing and KOBE Pumper . . . . .

3040 EAST SLAUSON AVENUE . . . HUNTINGTON PARK, CALIFORNIA, U. S. A.

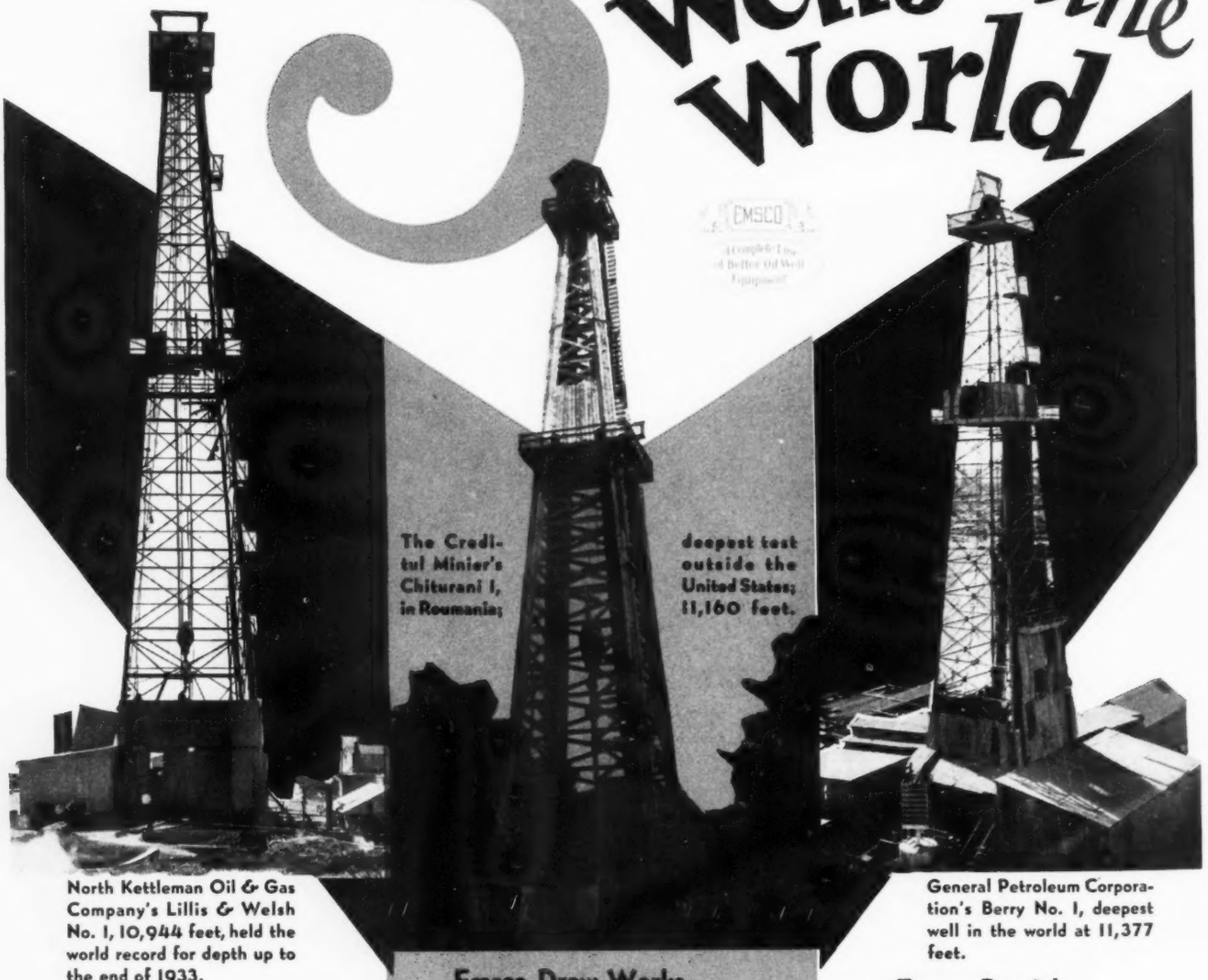


CALIFORNIA [redacted] in 1935

By DICK GUIBERSON

It's the purpose and intention
Of an A.P.I. convention
To inculcate and instill
In the minds of Tom and Bill
And the common rank and file
Of the boys who drill for ile,
The serious obligations
Of its deliberations;
That the intent of its actions
Must be free from fads and factions
And that union is the strength
To accomplish any length—
But still with all this work,
Which we shall not try to shirk,
Comes the weary end of day,
And the thought of simple play
Infests our weary minds;
And we segregate the kinds
Of amusements most alluring.
With decorum quite conjuring
We tread the paths Elysian,
Forgetting all adhesion
To the labor and the toil
Which has kept our blood a-boil.
In our efforts to appease you
We most surely hope to please you.
We can give you, for example,
(And a name or two is ample),
Some close-up introductions—
(You may make your own deductions)
But when you meet them in the flesh
Gosh all Hemlocks! What a mesh
Of mental abstractions
And focal reactions
Encounter every brain,
And you want to live again.
Then another potent reason,
Not entirely out of season,
Which we feel you should consider,—
The remoteness of the bidder.
California's fields are far,
But we feel they're on a par
With other states of fame
That have helped to make the name
Of oil a meaning thing.
And we want you here, to bring
To our busy rank and file,
Who cannot leave the while,
The good
That's understood.
We thank you.

the 3 deepest Wells in the World



The Credi-tul Miner's Chiturani I, in Roumania; deepest test outside the United States; 11,160 feet.

North Kettleman Oil & Gas Company's Lillis & Welsh No. 1, 10,944 feet, held the world record for depth up to the end of 1933.

Emsco Draw Works
Emsco Rotary
Emsco Swivel

General Petroleum Corporation's Berry No. 1, deepest well in the world at 11,377 feet.

Emsco Derrick
Emsco Draw Works
Emsco Rotary
Emsco Swivel
Emsco Crown Block

Emsco Draw Works
Emsco Rotary
Emsco Crown Block
Emsco Chain
Emsco Automatic Cathead

EMSCO DERRICK & EQUIPMENT CO.

6701-7101 South Alameda Street, Los Angeles, California, U. S. A.

All Emsco Machinery Sold Exclusively in the Mid-Continent Oil Fields by Continental Supply Company. ● All Emsco Derricks and Derrick Equipment Sold Exclusively in the Mid-Continent by Emsco Derrick & Equipment Company; Continental Building, Dallas, Texas.

Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City.

EMSCO

CALIFORNIA'S OIL

From Brea Beds to Record Depth Production . . .

A Brief Resume of the Petroleum Industry in California with a Chronological Record af Events Since 1900.

By WALLACE A. SAWDON
Petroleum Engineer
Los Angeles

WITHIN two years after the completion of the Drake well in 1859, the drilling of a well with the express intention of striking oil was started in California. Although the first accredited commercial producer was not completed until 1875 in this state, a number of wells were drilled before that time and a total crude oil production of 175,000 barrels has been estimated as coming from these wells and from other sources prior to this "first well." The commercial possibilities of crude oil had been demonstrated; surface seepages had indicated its presence. It was natural, therefore, that California should start its pioneer work in oil development so soon after the drilling of wells had been demonstrated as a means of obtaining this natural resource.

As in many other places throughout the world, the early inhabitants of California utilized the oil seepages and brea beds for waterproofing, for cementing, for medicine and for many purposes of which there is no record. As early as 1855, however, it is claimed by some historians that oil from seepages and hand-dug pits in Pico Canyon near Newhall—near the location of the first accredited producer—was used by General Andreas Pico for experimental purposes and for some form of refining. It is further claimed that a few years later a small refinery was built in Ojai Valley and that oil for its operation was taken from seepages and from holes dug in brea beds near Sulphur Mountain.

The more or less experimental operation of this refinery probably led to the drilling of what some claim to be the first well drilled in California. This was in 1866. According to other claims, there were, however, at least three wells drilled before this. One of these was drilled in Humboldt County in 1861 and another in Los Angeles County in 1863. Neither of these was commercially productive. It is also stated that oil was actually sold and refined from a well on the North Fork of the Mattole River in Humboldt County in 1865.

There seems to be general agreement in regard to the development of the Ventura-Newhall field which started with actual drilling in 1866. Early in 1865 a syndicate formed by Thomas Scott, who was connected with the Pennsylvania Railroad, had the first drilling equipment ever imported into the state sent out from Pennsylvania. This equipment included boilers, engines, casing, drilling tools, a refining still and wooden barrels for storage. Following it came Mr. Scott's two nephews, Thomas R. Bard and D. C. Scott. The former became an important factor in the oil development of the state and was later elected United States senator.

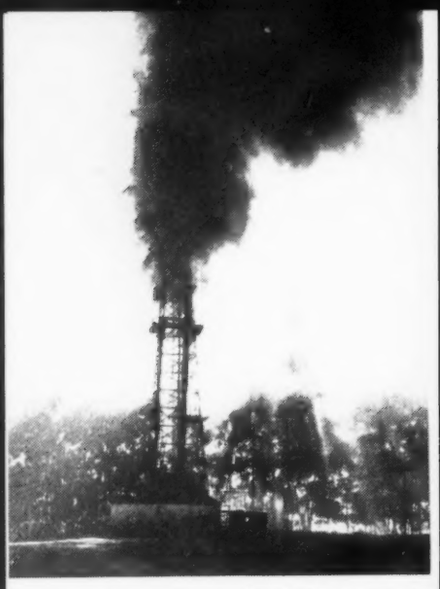
The first well of the syndicate was located just north of the present Ventura Avenue field and after being drilled to about 500 feet was completed, making a little oil and lots of water. This was so heavy and the quantity so small that a second well was drilled approximately five miles away to the same depth. This, too, was not successful in getting commercial production and was followed by four more wells in that district. One of these struck oil at less than 100 ft. and produced about five barrels per day. Another was drilled to 550 ft. and produced as high as 20 barrels for a number of years.

In the meanwhile, Leland Stanford completed an 80-ft. tunnel into the steep dipping oil sands on the south slope of Sulphur Mountain. Similar developments followed both at Sulphur Mountain and at McKittrick until 30 tunnels had been driven to production. These ranged in length from the first one of 80 ft. up to the longest of 1600 feet. They were so inclined that the oil ran by gravity to the portals where it was collected in ditches and in these transported to wooden tanks. The product was hauled to the nearest port and shipped from there with the greatest portion going to San Francisco.

It has been claimed that the first well ever drilled in California was put down by A. J. Salisbury at the foot of Sulphur Mountain. The date is given as 1867 and the drilling was done for Bard. No commercial production was procured but a recent statement tells of oil rising

Right: First commercial refinery in California, built near the town of Newhall.

Extreme right: First commercial producing well in California — Pico Canyon, near Newhall.



Discovery well of the Elwood field, California—Barnsdall Oil Company's Luton Bell No. 1

to the surface in this well at the present time.

First Accredited Commercial Producer

In spite of the fact that estimates place the total oil production of California at 175,000 bbl. prior to 1876, the credit for the first commercial production has been given to a well drilled in Pico Canyon in 1875. While there is an agreement that this well was drilled by C. A. Mentre (or Mentry), a former Pennsylvania driller, some records show that the well was drilled to only 75 ft. and that the production obtained was but five or six barrels per day. Other records claim the well as drilled by Mentre was a deepening of a well previously drilled by Sanford Lyon in 1870; and that, although Mentre had drilled previous wells in Pico Canyon, the real production from the first accredited commercial producing well was 150 barrels per day and was from a depth of 600 ft. drilled in 1879.

During 1875, Ex-Mayor Bryant of San Francisco, D. G. Scofield (who later became president of the Standard Oil Company) and others organized the California Star Oil Company. This company acquired the Mentre holding and built California's first refinery at Lyon Station near Newhall. Here again is entered a counter claim that a refinery built and operated by the Stanford Brothers at San Francisco was the first to refine California crude oil on a commercial scale.

About two years after the construction of the Newhall refinery, it was either enlarged or rebuilt. Probably the site for the new plant was closer to the town of Newhall, although some of the equipment from the older refinery was probably used in its construction. At any rate, the refinery placed in operation near Newhall in 1879 has been given general credit as being the first one in the state. It was restored by the Standard Oil Company in November, 1930, and clearly shows the methods of operation used for the refining of crude oil during the earliest period.

Accompanying the construction of this first refinery was the laying of the first pipe line in the state. This was a five-mile, 2-in. line composed of cast iron pipe which carried the crude oil from the Pico Canyon operations to a storage tank located above the refinery.

Another refinery had meanwhile been built at the mouth of the Little Sespe Creek near Fillmore. The oil for this came from a well that had been drilled in the Sespe Canyon in 1877. The products from this plant consisted of kerosene which was sold in Los Angeles, and lubricating oils which were shipped to San Francisco. This refinery, built in 1878, and another one of about 20 bbl. capacity built at Santa Paula in 1879 were probably in operation when the Newhall plant was enlarged or rebuilt.

Other Early Developments

The first drilling of wells in Moody Gulch near San Jose occurred about the same time as the Pico Canyon development. The first well here was drilled by W. E. Youle, who claims that he put down the first commercial well in the state. Some of the wells in this field made 50 bbl. per day and one of the wells drilled by Youle made 100 barrels. This well was deepened and then produced 150 bbl. per day.

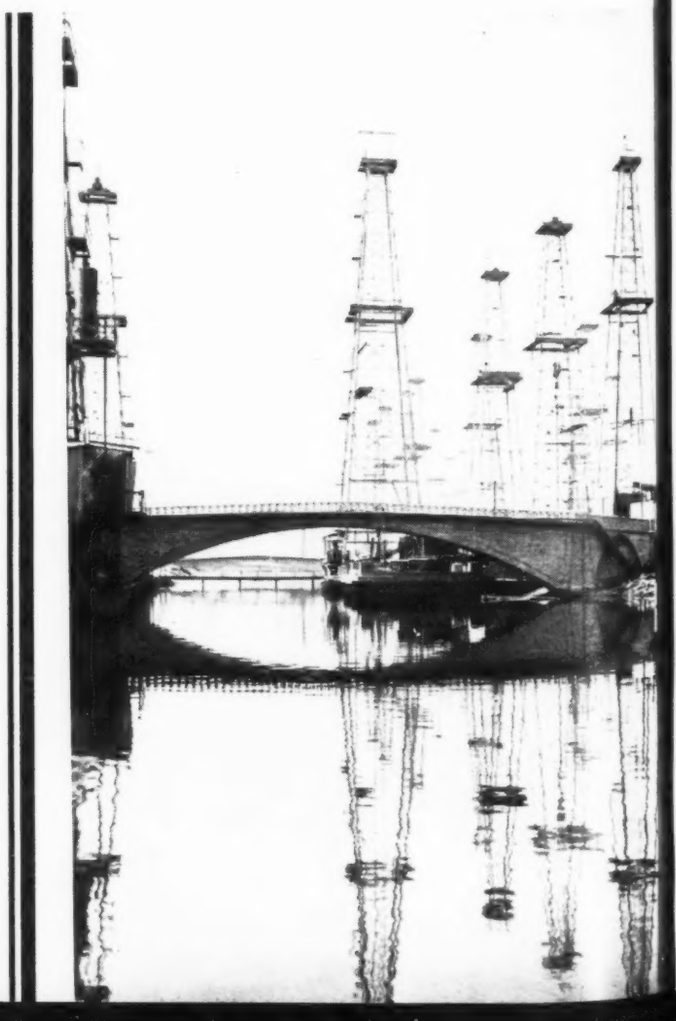
The next discovery of importance was in the Brea-Olinda district with wells being drilled in Brea Canyon and Puenta Hills about 1879 and 1880. Other discoveries followed in various localities. Although discoveries have been credited by some to Summerland in 1887, to Coalinga and McKittrick in 1890 and to Midway-Sunset in 1891, there are no production figures to show that they were producing areas until later dates. Up until 1894, all production from the state is given as coming from the Ventura-Newhall district and during the year 1893 had reached an annual figure of 470,000 barrels.

In 1885 the first pipe line carrying oil to tidewater was constructed from Santa Paula to San Buenaventura. This was a 4-in. line, 16 miles in length, which carried the oil by gravity to storage tanks from which it was loaded into tankers that were put into commission for the purpose. Other lines were laid from wells into Santa Paula to feed into the tidewater pipe line.

The first pipe line in Los Angeles County was laid in the following year, 1886. This was a 5-mile, 2-in. line that carried oil to a loading station at Puenta from the Puenta Hills where wells, drilled to from 800 to 1600 ft., were being brought in with productions ranging from 25 to 150 bbl. per day.

Annual Production Passes Million Barrels

The first production from the Los Angeles field seems to have come from hand-dug pits. This was in 1893. A number of wells were immediately drilled, however, and there were soon so many of these that the state's first over-production followed within two or three years. The annual production for California passed the one million barrel mark in 1895 and



View taken in the Venice (Playa Del Rey) field

PATENTED

Check THESE IMPORTANT FEATURES

. . . and compare them with *your present reamer*

1. POSITIVE shearing action.
2. Increased amount of wall contact.
3. Patented cutter assembly eliminates body repair.
4. No replacement of parts required (including main pin) per assembly.
5. Maximum clearance between body and drilled hole.
6. Easy shearing action, eliminating excessive torque on equipment.
7. Lowest cost per foot of hole.
8. Highest quality of material and workmanship.

Write for Catalog No. 3

SECURITY ENGINEERING CO.
WHITTIER CALIFORNIA

Exclusive California Distributors of "Mission Products"

Mid-Continent Distribution

WILSON SUPPLY CO.
HOUSTON TEXAS

The SIEVERS REAMER

...YOU CAN

INCREASE YOUR PRODUCTION

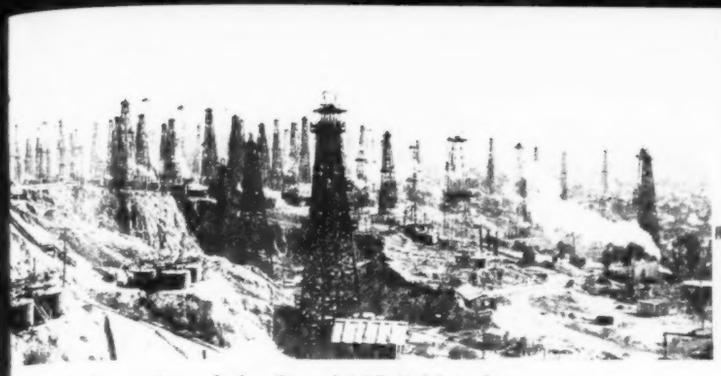
AND LOWER LIFTING COSTS

WITH AXELSON PUMPS

AND SUCKER RODS

AXELSON MANUFACTURING COMPANY

P. O. Box 710, Vernon Sta., Los Angeles, California; 50 Church Street, New York; Tulsa; St. Louis; Mid-Continent and Eastern Distributor: Frick-Reid Supply Corp.; Rocky Mountain Distributor: Great Northern Tool & Supply Co.



A portion of the Signal Hill field today

Signal Hill, May 30, 1921

Left: Section of Santa Fe Springs field today. Above: Union Oil Company of California's Meyer No. 3, discovery well of Santa Fe Springs field. Finished in October, 1919, the drilling time was two years and seven months

of the total of 1,245,339 bbl. produced, 749,695 bbl. were taken from the Los Angeles field.

Meanwhile, during 1894, Summerland had produced about 1800 bbl. and other fields about 15,000 barrels. By 1896, production had started coming from Coalinga, by 1897 from Fullerton, and by 1898 from McKittrick. Although the Kern River field was discovered in June, 1899, production from it and from Sunset was first reported in 1900.

By 1900 the total production from the state passed four million barrels per year. In the following year, the Midway field started to produce and in 1902, with the Santa Maria field area discovered, the state's production reached nearly fifteen million barrels per year.

From that time on, development and production advanced rapidly but consistently until the middle of 1914 when production fell off for a period of about six years. From the middle of 1920, California's production started on a more rapid advance until the high point of 1923 was reached. During this three-year period it was interrupted by the strike in the fall of 1921; but this did not prevent the annual total from exceeding that of the previous year.

From 1924 to 1928, production remained fairly constant; but in 1929, California, like the rest of the country, produced the greatest amount of oil in its history.

Chronological Highlights

Detailed reports on even the outstanding events in California oil history cannot here be given; and no attempt is made to list all the pools and fields that have contributed to make oil one of the biggest industries in the state. Certain highlights, however, are necessary in the briefest of historical summaries and these are presented chronologically for the period extending from 1900 to the present time.

1900 — In addition to the discovery at Sunset and the first production from the Kern River field, continued increases from fields already developed started a six-year period of over-production. Summerland had just produced its peak and toward the end of the year Watsonville reached its peak.

1901 — Whittier, Midway and Santa Maria were discovered.

1902 — Salt Lake field at Los Angeles was discovered.

1903 — Extensive development was carried on at Coalinga.

1904 — Kern River reached a peak of 55,000 bbl. per day and Lompoc was discovered.

1905 —Slight rise in production from fields already developed.

1906 — With production over 34,000,000 bbl , relief was brought by the general use of oil for locomotive fuel. This actually caused a shortage for a few years. West Coyote was discovered.

1907 — Salt Lake was rapidly developed and production increased from McKittrick, Santa Maria and Lompoc.

1908 — Beverly Hills was discovered and Santa Maria and Lompoc reached peak production.

1909 — Buena Vista Hills discovered; peak production from Salt Lake and Beverly Hills and from McKittrick.

1910 — On March 14 of this year, the Midway-Lakeview gusher was brought in. Discoveries during the year were Devils Den, Lost Hills, Arroyo Grand and North Midway.

1911 — Cat Canyon and East Coyote were discovered.

1912 — North Belridge and Kern Front were discovered. Coalinga reached a peak of 60,000 bbl. per day.

1913 to **1915** — First peak productions were reached at North Belridge, Lost Hills and Devil's Den.

1914 —-Midway-Sunset-Buena Vista reached a peak of 235,000 bbl. per day.

1915 — Drilling at the end of 1915 was cut down because of over-production.

1916 — Ventura Avenue and South Mountain discovered.

1917 — Entry of the United States into the World War increased demand for petroleum. The important discovery of this year was the Montebello field. Another discovery was at Casmalia. East Coyote reached a peak production and Lost Hills-North and South Belridge reached a second peak.

1918 — West Coyote reached peak production.

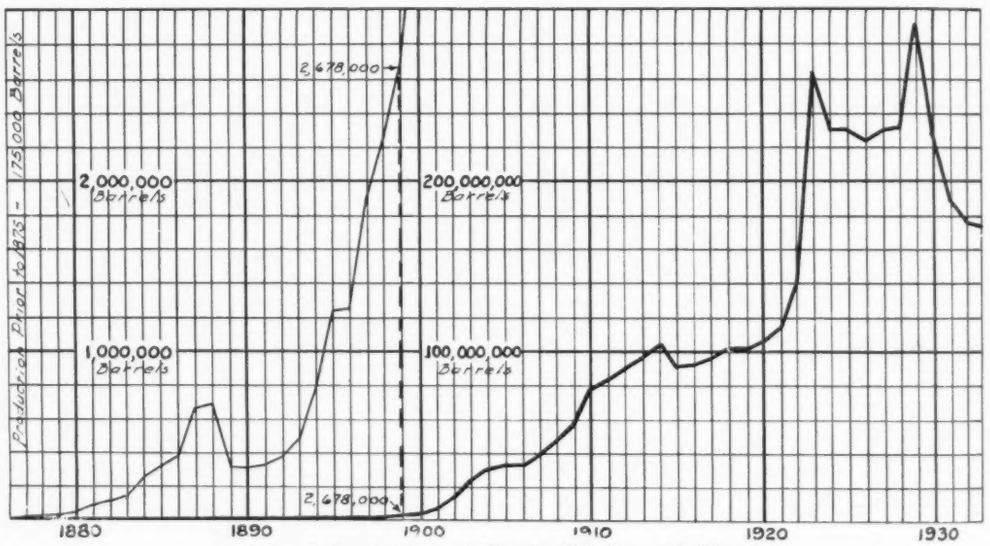
1919 — Starting a period of great importance in California oil history, the Santa Fe Springs field was discovered on October third. Previously in this year, West Elk Hills and Richfield had been discovered and Montebello had reached a peak of over 40,000 bbl. per day.

1920 — After discovery in East Elk Hills, the Huntington Beach field was discovered and started adding its production to that of Santa Fe Springs.

1921 — Following the important developments in Santa Fe and Huntington Beach, the Long Beach field was discovered. Elk Hills meanwhile reached a peak production of 62,000 bbl. per day and Richfield over 30,000 bbl. per day. From September 12 to November 2 the oil worker's strike occurred.

1922 — California shipments of oil through the Panama Canal to the Atlantic Coast began during this year. Torrance, the Lloyd Zone in the Ventura Avenue field, and the Wheeler Ridge field were discovered. A drilling campaign was started in the Meyer Zone at Santa Fe Springs and the Ashton Zone of Huntington Beach reached a peak. Meanwhile, production in the San Joaquin Valley was curtailed in May and again in December.

1923—Production in the Los Angeles Basin increased with Huntington Beach reaching a peak of 116,000 bbl. per day, Santa Fe Springs 341,500 barrels per day and Long Beach 284,000 bbl. per day. Dominguez was discovered during this year also. On April 20th a proration committee was organized.



Annual Production of Crude Oil from California

1924 — Discoveries during this year included Athens-Rosecrans, Kern Front Main Area and Inglewood. Torrance and Wheeler Ridge reached peak productions and Long Beach went from flowing to pumping.

1925 — Dominguez, Inglewood and Athens-Rosecrans reached peak productions.

1926 — The Los Cerritos area of Long Beach was intensively developed while the Huntington Beach Townsite, Seal Beach and Mount Poso were discovered. Brea-Olinda reached peak production.

1927 — The deepening campaigns at Long Beach and Santa Fe Springs started. Potero, Round Mountain and Rincon were discovered. Alamitos-Seal Beach and Whittier reached peak production.

1928 — The most important development for several years was the discovery of the Kettleman Hills field on October 5, 1928. This had just been preceded by the Buckbee Zone discovery at Santa Fe Springs while earlier in the year Maricopa Flats, Fruitvale, Midway Deep Zone, Lawndale and Elwood had been discovered.

1929 — Extensive development was conducted in the Long Beach and Santa Fe Springs deep zones and at Elwood. Nordstrum and Buckbee productions at Santa Fe Springs reached peaks and Santa Barbara was discovered. The Van Deinse curtailment occurred in May and June. Lawndale and the O'Connell at Santa Fe Springs reached peaks. The Long Beach and Santa Fe Springs deep zones started producing. Ventura's peak production came in August; and Kettleman Hills increased production. Capitan was discovered. Then on November 1st, Long Beach and Santa Fe Springs were curtailed. On December 18, Playa Del Rey (Venice) was discovered.

1930 — Ventura and Elwood were curtailed but Elwood reached a peak production. Flow tests were made on deep zone wells at Huntington Beach, Seal Beach, Long Beach and Santa Fe Springs; and the Clark Zone of Santa Fe Springs reached peak production. The state curtailment program began March 15. Peak productions were then reached at Potero and Playa Del Rey. Discoveries were made of the Temblor Zone in North Belridge and of the Kettleman Lower sand.

1931 — Neal Anderson was elected state oil umpire in August. During the year discoveries were made at Gato Ridge, North Belridge Deep Zone, Elwood-Sespe Zone, San Miguelito and the Kettleman Middle Dome.

1932 — J. R. Pemberton was elected state oil umpire July 13. Deep zone development started at Dominguez and flow tests were made at Santa Fe Springs and Playa Del Rey.

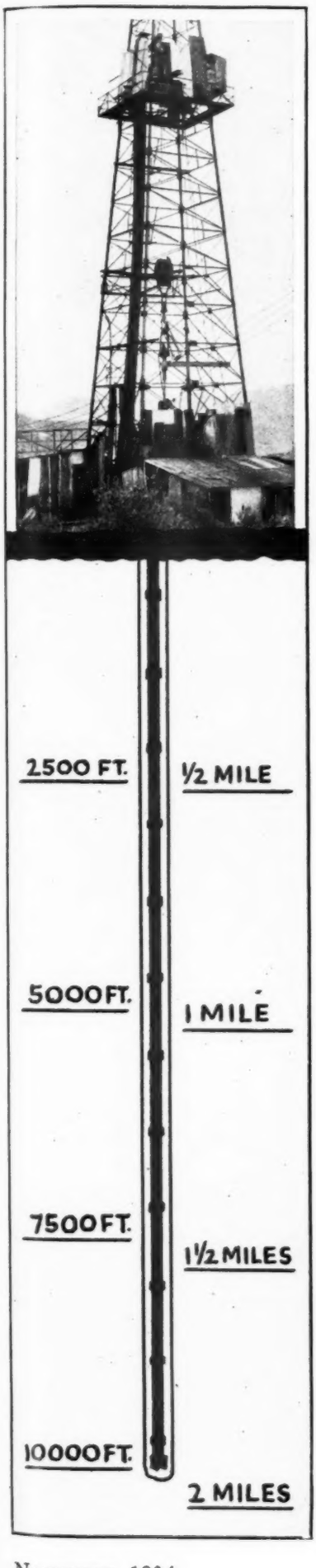
1933 — The earthquake in the Los Angeles Basin in March showed its effect on the state's production for only one month. Mountain View and the Montebello Miocene Zone were discovered.

Curtailment of production in California probably has been as effective as in any other oil prducing area in the United States. The potential production at the present time is estimated at 1,500,000 bbl.; yet the daily production is being kept down to about half a million barrels.

The development of deeper sands, the discovery of lower productive horizons in existing fields and the great possibilities of discoveries in many new areas, especially north and west of Bakersfield to areas beyond Kettleman Hills, make the future prospects for the oil industry in California exceedingly bright.

Acknowledgments

Appreciation for coöperation in compiling data for this article is extended to Laurance R. Cook of the California Oil and Gas Association, who provided considerable information and several photographs belonging to the Association. The chronological history from 1900 to date was compiled to a great extent from data supplied by the Independent Oil Producer Sales Agency of California.



Safety at any depth

•

PATTERSON-BALLAGH PROTECTORS

The deeper the well, the greater the punishment that Protectors must withstand. Patterson-Ballagh Protectors are the universal selection of experienced superintendents, because of their known stamina and ability to resist wear and take abuse. There is a reason for this long service life and wide acceptance.

Patterson-Ballagh Protectors are produced by an Organization which *pioneered* the manufacture and sale of Protectors.

Look for the name on each Protector . . .

PATTERSON-BALLAGH

•

PATTERSON-BALLAGH CORPORATION

1900 East 65th St., Los Angeles, Calif.

New York Office: 39 Cortlandt Street

BETTIS SALES COMPANY

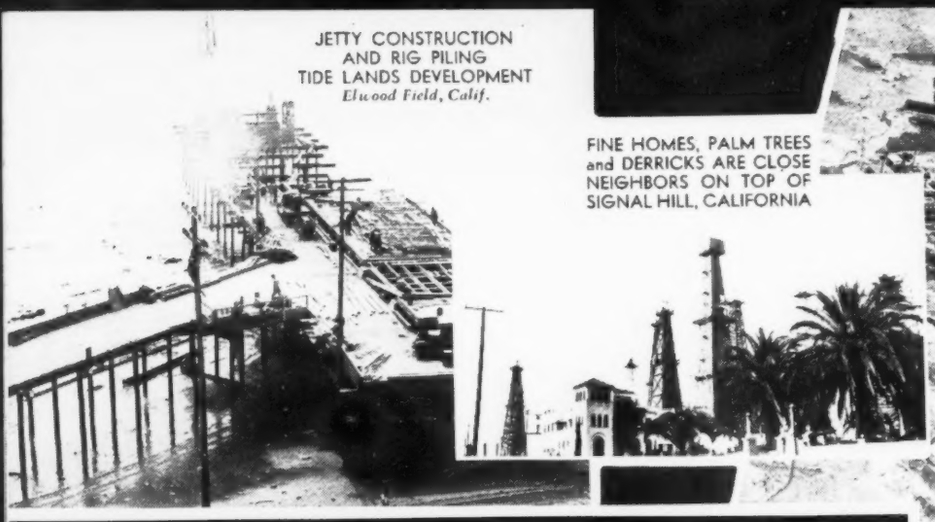
516 Merchants and Manufacturers Bldg.

Houston, Texas

THE NATIONAL SUPPLY COMPANY

Tulsa, Oklahoma

REPRESENTATIVE CALIFORNIA REFINERIES AND FIELD VIEWS



JETTY CONSTRUCTION
AND RIG PILING
TIDE LANDS DEVELOPMENT
Elwood Field, Calif.

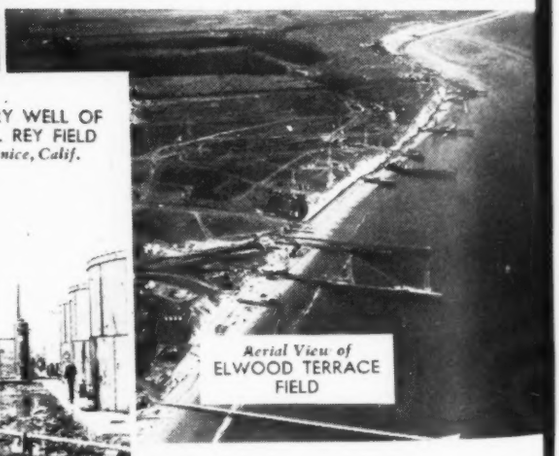
FINE HOMES, PALM TREES and DERRICKS ARE CLOSE NEIGHBORS ON TOP OF SIGNAL HILL, CALIFORNIA

STANDARD OIL REFINERY
AND TANK FARM
at El Segundo, California

MOORE RANCH
Elwood Field, California

RICHFIELD OIL REFINERY
Hynes, California

DISCOVERY WELL OF
NEW DEL REY FIELD
Near Venice, Calif.



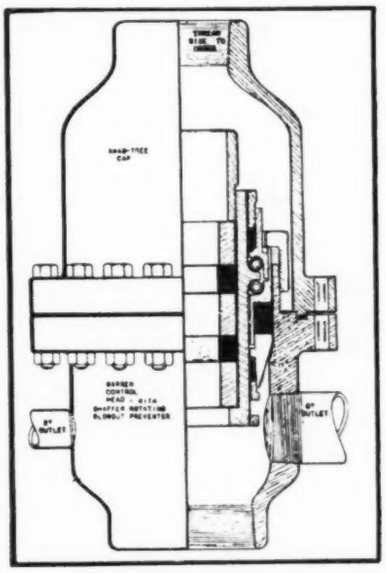
Aerial View of
ELWOOD TERRACE
FIELD

GENERAL PETROLEUM COMPANY PLANT
at Torrance, California

Vinvale, California
REFINERY AND WORKS OF
THE RIO GRANDE OIL CO.

SHAFFER SAFETY FIRST AND HIGH PRESSURE EQUIPMENT

ROTATING BLOWOUT PREVENTER

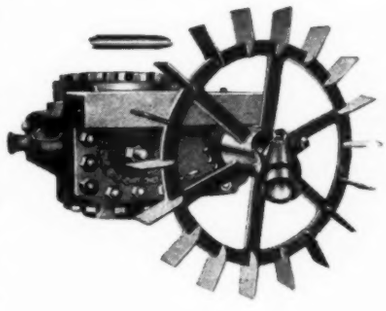


The Shaffer Rotating Blow-Out Preventer consists of a steel bowl in which is a complete packing assembly that is held in place with a bonnet. This assembly provides for packing either around the grief stem or around the drill pipe; and both types may be furnished with each preventer.

The essential part of the assembly is a long sleeve which rotates within the packer and which is carried on two sets of ball bearings to eliminate friction. Inside this are steel bushings and rings of oil-resisting rubber packing that are shaped to fit at particular sized Kelley or pipe. These prevent leakage as they revolve with the Kelley or pipe.

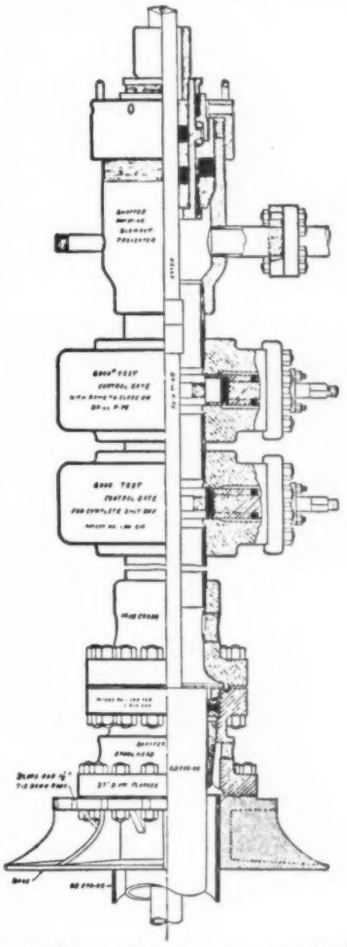
Complete protection is provided when the well is drilling.

CELLAR CONTROL GATE WITH POWER ATTACHMENT



The Shaffer Cellar Control Gate is universally used as a safety measure in drilling oil wells in high-pressure fields of the entire world. It is a simple device which is closed manually from outside the derrick with but one hand wheel. Power means in addition to manual control, for operating gates may easily be furnished without changing design of gate. The whole design is so compact that two of these gates can be installed in the cellar in approximately the same space occupied by the conventional drilling valve. This gives the operator protection both with pipe in and out of the hole.

HIGH-PRESSURE DRILLING HOOK-UP



This high-pressure cellar assembly, with its combination of casingheads, mud cross, control gates, overflow vent, blow-out preventer and capping connection for bringing in the well, provides both emergency and permanent protection.

Flanged onto the Spool type heads at the bottom is a Shaffer high-pressure mud cross with 4-inch and 2-inch outlets.

A pair of Shaffer Cellar Control Gates are shown. One provides protection "out of the hole" when there is no drillpipe present, and replaces the old-style drilling valve.

The upper gate closes around the drillpipe or tubing, giving dependable protection "in the hole." Both gates are used with Shaffer Universal joint connections, giving remote control from any place outside the derrick.

Above the gates is installed a blowout preventer with the Shaffer Rotating Packing Assembly. This assembly packs off and revolves with the Kelley, thus giving protection while drilling. When pulling drill pipe the stationary packing assembly may be used in connection with the gates.

The Warren flanged Christmas tree cap may be used as another safety feature of this hook-up.

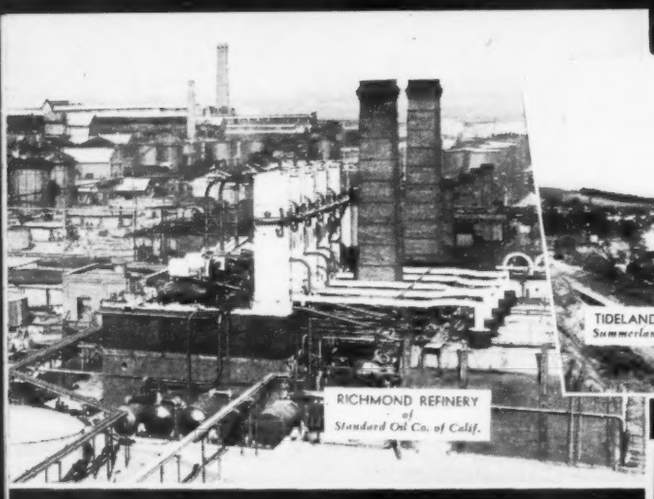
Below the mud cross the cut shows our Spool Type Landing Heads. This demonstrates how conveniently the whole high-pressure hook-up may be installed.

*We manufacture a complete line of Casing Heads, Tubing Heads and Flow Beans. Write for 1934 Shaffer Catalogue.

SHAFFER TOOL WORKS

Brea, California — Houston, Texas

FOREIGN OILWELL SUPPLY COMPANY



RICHMOND REFINERY
of
Standard Oil Co. of Calif.

TIDELAND DRILLING
Summerland, California

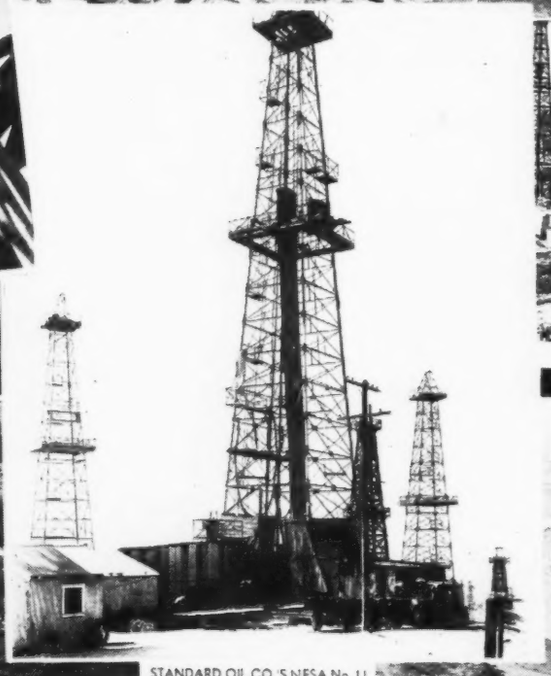
VERNON REFINERY
of
GENERAL PETROLEUM CORP.

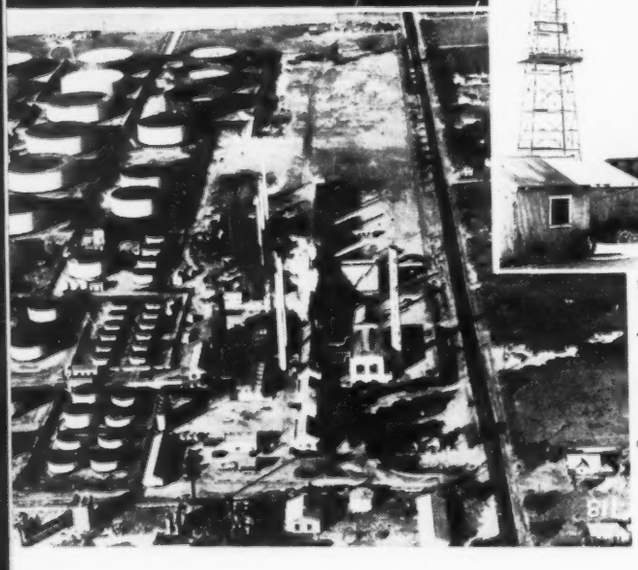
Photo of
DERRICK INTERIOR
TAKEN AT SUNSET,
Signal Hill, California
Shell Photo

EL SEGUNDO
REFINERY OF
STANDARD OIL CO.

DOMINGUEZ FIELD
CALIFORNIA
Illustrating Orderly Development Under Unit Operation

In the
SIGNAL HILL
OIL FIELD

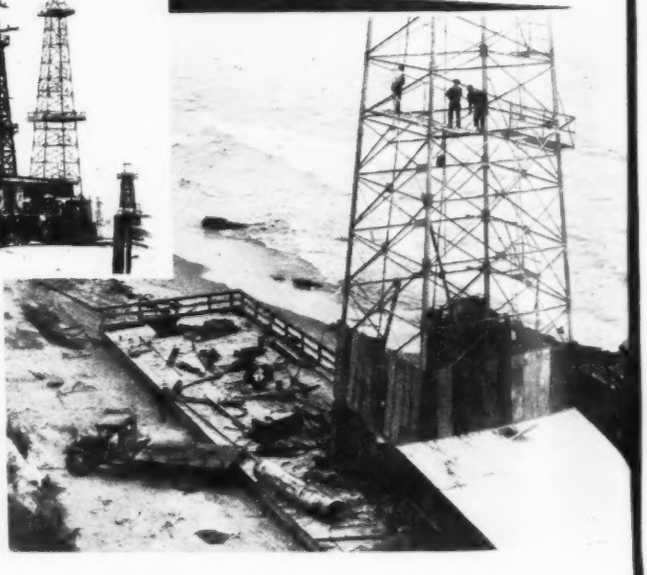


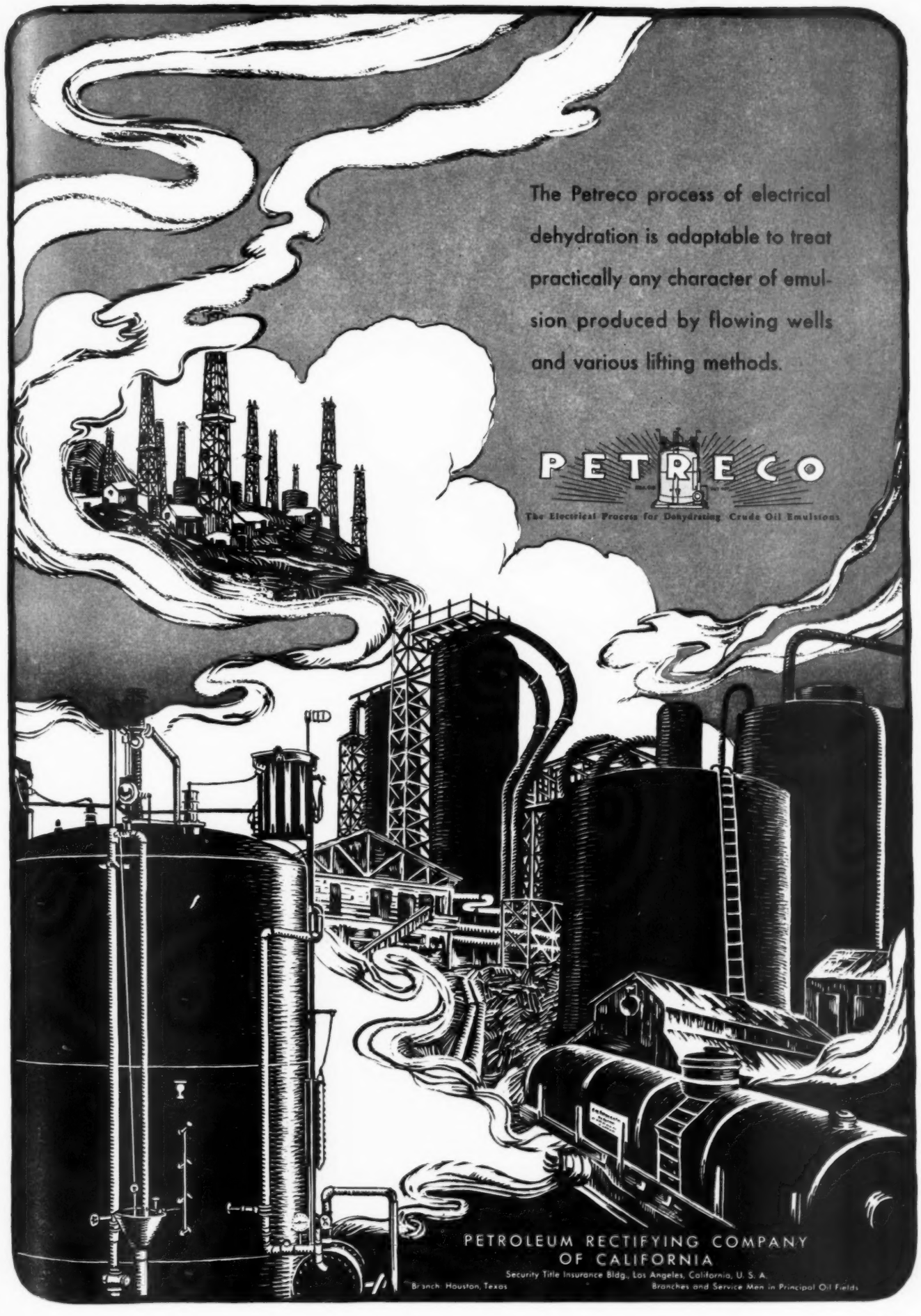


STANDARD OIL CO.'S NESA No. 11
LONG BEACH, CALIFORNIA
Drilled to a depth of over 9000 ft.

ONE OF
RICHFIELD
OIL CO.'s
CALIFORNIA
REFINERIES

RIGGING
UP AN
ALL-STEEL
DERRICK
AT
ELWOOD
FIELD
California




The Petreco process of electrical dehydration is adaptable to treat practically any character of emulsion produced by flowing wells and various lifting methods.
PETRECO
The Electrical Process for Dehydrating Crude Oil Emulsions
PETROLEUM RECTIFYING COMPANY
OF CALIFORNIA
Security Title Insurance Bldg., Los Angeles, California, U. S. A.
Branch: Houston, Texas
Branches and Service Men in Principal Oil Fields

THE "QUINTUPLEX" SMILE

"Quintuplex" is a combination of five important drilling control instruments: **A temperature-compensated, full-range Weight Indicator, Supersensitive Weight Indicator, Torque Gauge, Slush Pump Gauge and Rotary Table Tachometer**—all conveniently fitted in one case.

"QUINTUPLEX"—*The New Drilling Control Instrument That Takes All the Guess Out of Drilling.*

Little wonder Driller J. R. Huggins is smiling—all of his nerve-wracking guesswork has been eliminated, because Allan & Morris, Texas drilling contractors, have seen to it that Huggins and the rest of their drillers have Martin-Decker Quintuplex Drilling Control Instruments on the job. The Quintuplex shows A.-M. drillers exactly what is happening in the hole every minute of the day—they don't have to guess.

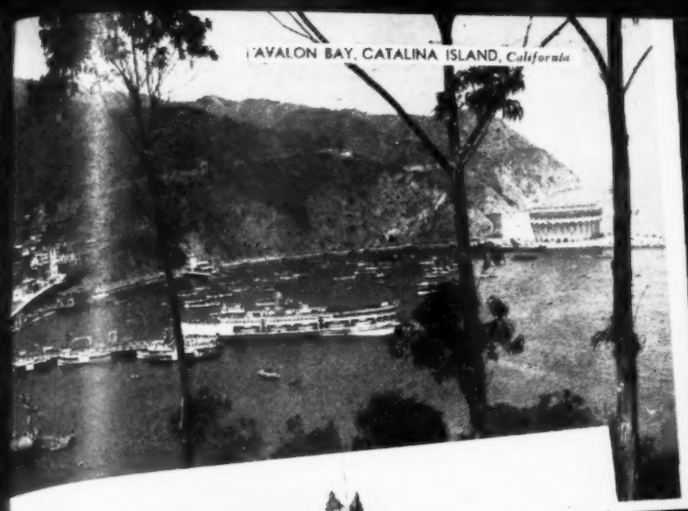
Notice the mounting—the instrument is set close to the driller's position, but does not interfere with the operation of the draw works or impair visibility.

The slightest change in drilling condition is reflected by the Quintuplex and can be detected instantly by the driller without nerve or eye-strain.

THE WEIGHT INDICATOR
MARTIN DECKER CORP.
LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Oildale, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

A GROUP OF TYPICAL CALIFORNIA SCENES

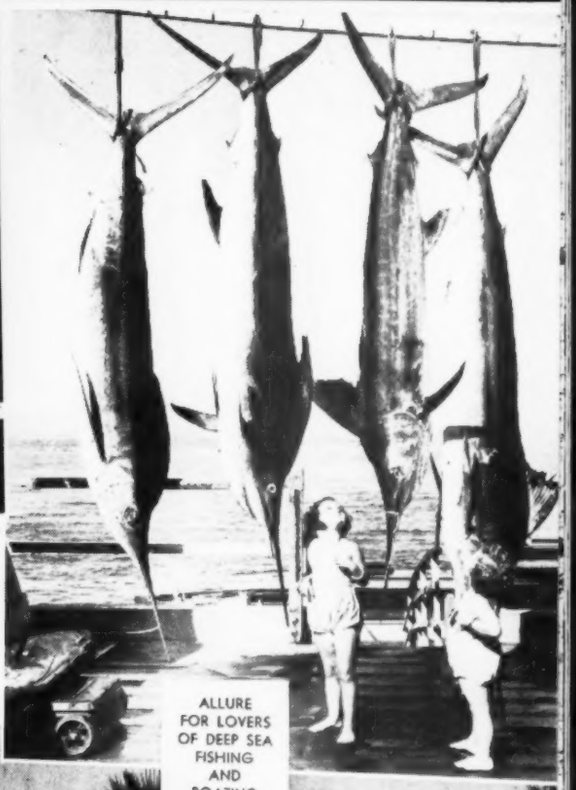


AVALON BAY, CATALINA ISLAND, *California*

LOADING ORANGES FOR SHIPMENT, *Los Angeles Harbor*

WILSON BUILDING, HUNTINGTON PARK, *Los Angeles*

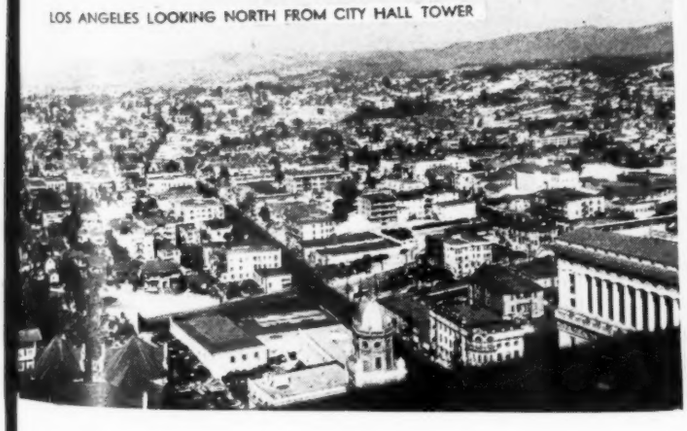
YOSEMITE NATIONAL PARK'S WORLD FAMOUS FIRE FALL FROM GLACIER POINT

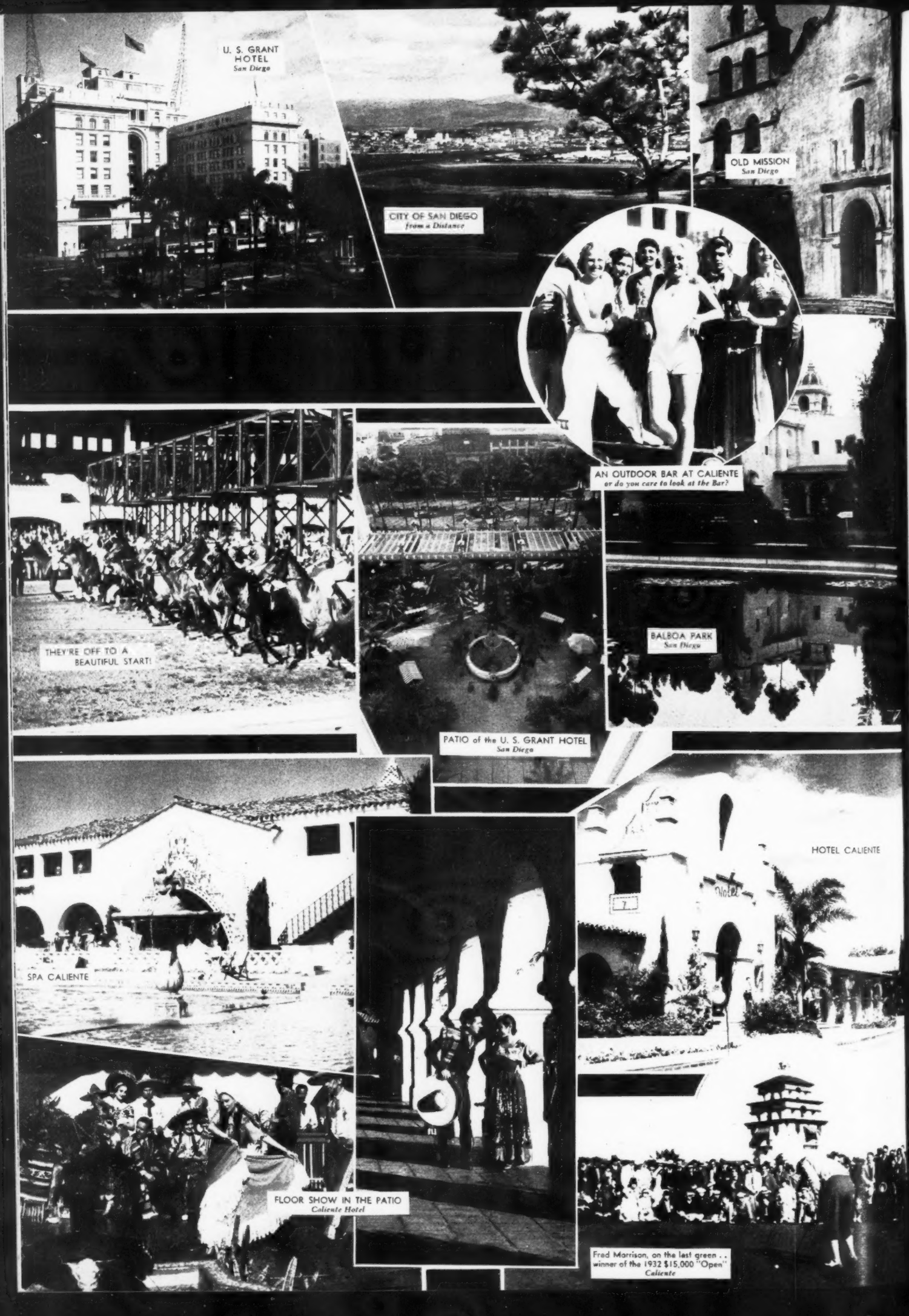


ALLURE FOR LOVERS OF DEEP SEA FISHING AND BOATING

PALMS AND SNOW-CAPPED MOUNTAINS NEAR FOOTHILL BOULEVARD, *Los Angeles*

LOS ANGELES LOOKING NORTH FROM CITY HALL TOWER




U. S. GRANT HOTEL
San Diego
CITY OF SAN DIEGO
from a Distance
OLD MISSION
San Diego
AN OUTDOOR BAR AT CALIENTE
or do you care to look at the Bar?
THEY'RE OFF TO A BEAUTIFUL START!
PATIO of the U. S. GRANT HOTEL
San Diego
BALBOA PARK
San Diego
SPA CALIENTE
FLOOR SHOW IN THE PATIO
Caliente Hotel
HOTEL CALIENTE
Fred Morrison, on the last green . . winner of the 1932 $15,000 "Open"
Caliente

THE BILTMORE HOTEL
LOS ANGELES

● **The Biltmore Hotel is the recognized headquarters for oil men, and was official headquarters for the Petroleum Institute during their last convention held in California. It will be happy to welcome you again in 1935.**

● **The Biltmore is the center of the city's life. The Biltmore Bowl is the largest and one of the finest night clubs in the world. It presents a marvelous floor show and a world-famous orchestra. The Rendezvous is popular for afternoon dancing. Five restaurants, with most moderate prices.**

Room rates recently reduced, and all rooms have private baths and circulating ice water.

REGAN FORGE & ENGINEERING CO., *San Pedro*

CALIFORNIA-MADE PETROLEUM EQUIPMENT IS WIDELY USED--HERE ARE A FEW OF THE MANUFACTURING PLANTS

FILTROL COMPANY, *Los Angeles*

BYRON JACKSON COMPANY'S VERNON PLANT, *Los Angeles*

BYRON JACKSON COMPANY'S BERKELEY PLANT, *Berkeley*

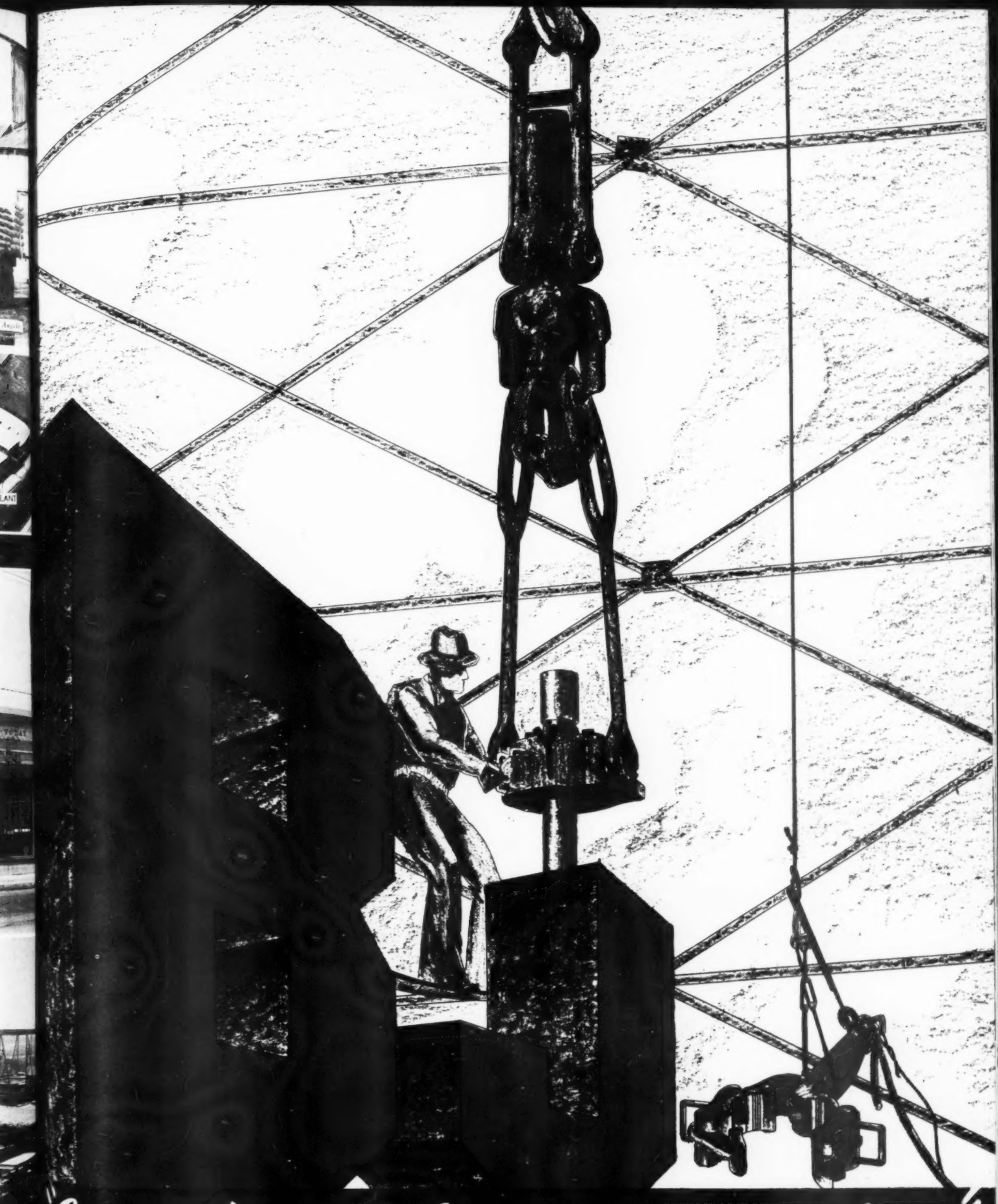
BYRON JACKSON COMPANY'S SLAUSON AVENUE PLANT *Los Angeles*

MARTIN-DECKER CORP., *Long Beach*

ALEXANDER ANDERSON, Inc. *Fullerton*

THE LANE-WELLS CO., *Los Angeles*

PIPE AND STEEL YARDS OF DUCOMMUN CORPORATION, *Los Angeles*

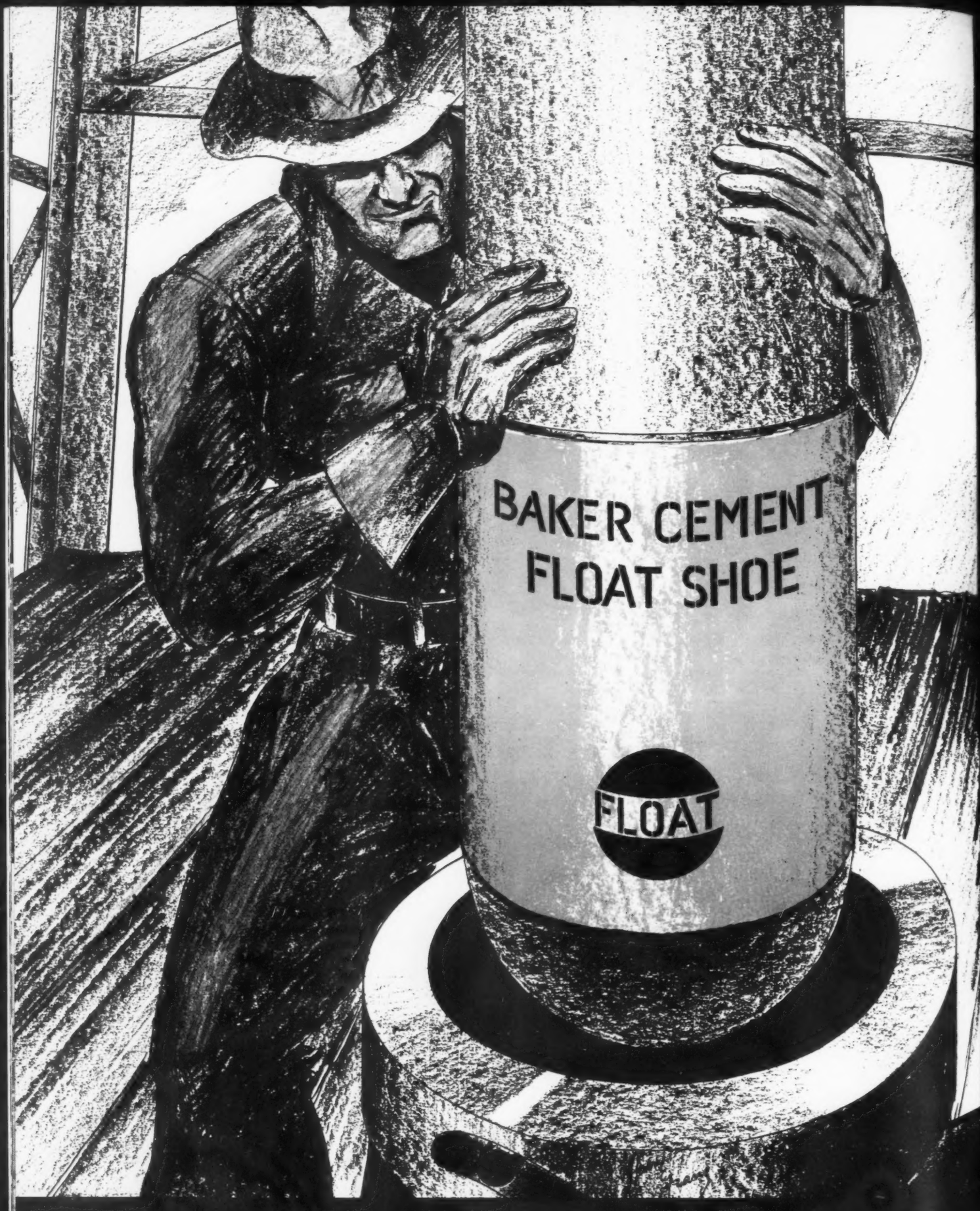


Come Out and see us sometime

BYRON JACKSON CO.

DRILLING AND PRODUCTION TOOLS

Fort Worth · Los Angeles · New York

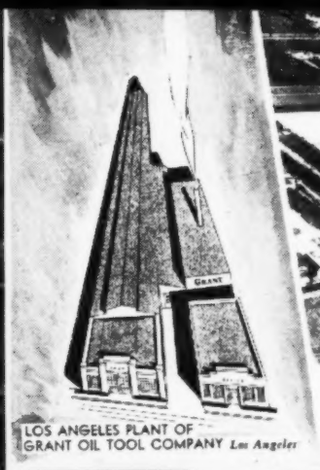


We join in extending to the Directors and Members of American Petroleum Institute our cordial invitation to hold the Annual Meeting for 1935 in Los Angeles.

A hearty welcome awaits you.

BAKER OIL TOOLS, INC.

D&B PUMP & SUPPLY CO., *Los Angeles*



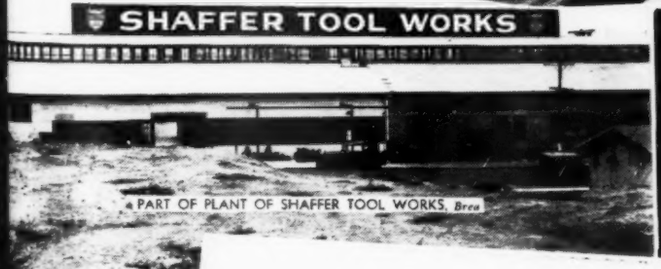
LOS ANGELES PLANT OF
GRANT OIL TOOL COMPANY *Los Angeles*

AERIAL VIEW OF THE C. F. BRAUN & CO. PLANT *at Alhambra*

SAN FRANCISCO PLANT OF MERCO NORDSTROM VALVE COMPANY
Subsidiary of Pittsburgh Equitable Meter Company

H. JOHN EASTMAN, *Long Beach*

AXELSON MANUFACTURING CO., *Los Angeles*



PART OF PLANT OF SHAFFER TOOL WORKS, *Brea*

MANUFACTURING PLANT OF HYDRIL COMPANY, *Los Angeles*

PACIFIC OIL WELL CEMENTING COMPANY, *Long Beach*

PATTERSON-BALLAGH CORPORATION, *Los Angeles*

California Crude Oil Production

A brief explanation of the graph-history over a decade and a half

By
THOMAS H. SHERMAN
Assistant General Manager Oil Producers' Sales Agency of California

PRELIMINARY to the explanation of this graph-history of crude petroleum production in California for the period shown by the chart accompanying this article, it is suggested that the following facts be kept in mind:

THOS. H. SHERMAN

1. California oil fields have a potential producing capacity of 1,415,210 barrels daily, as of October 1, 1934. These well potentials are obtained from the published statistics of the oil umpire's office.
2. Despite critical rumors and some direct complaints to the contrary, sporadic tests have demonstrated to a reasonable degree the accuracy of these potentials.
3. California's daily allowable production under curtailment—by order of the petroleum administrator—was fixed for the month of October at 452,300 bbl. daily.
4. The present machinery of operation under curtailment and proration in this state is in form and substance essentially the same as that provided under voluntary coöperation for several years prior to its assumption by government under the Petroleum Code.

The comment might be made that this same machinery has continued to operate successfully under the Code, despite the handicaps at times imposed by governmental interference. The claim is made, and is susceptible of proof, that practically all accomplishments having to do with curtailment and proration to date in California have been brought about by and through voluntary coöperation.

In a study of this state's production curve, it is important that even a superficial presentation of these facts and contentions be made, hence this preliminary statement.

Prior to the years shown on the chart, California's crude petroleum production gradually rose through periods of "over-production" with crude petroleum and its products eventually finding their place in Pacific Coast, Atlantic Seaboard, or world markets.

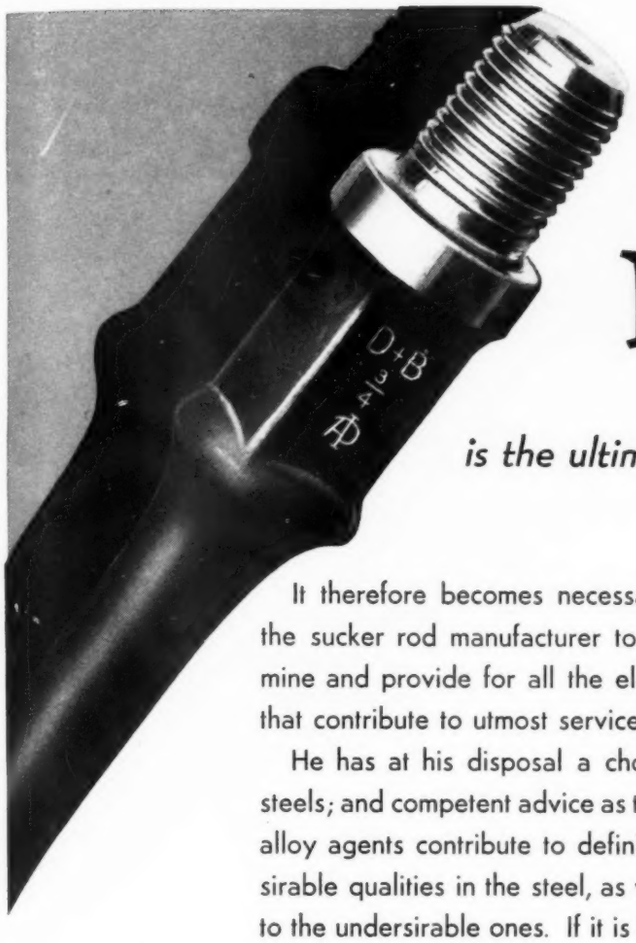
Old-timers in the oil industry of this state recall the first period of over-production, as far back as 1900, with the development of the Kern River field and its "forest of derricks." Even *lack of storage* was one of those early day problems, as there were not sufficient empty wine-casks or vinegar barrels readily available for the heavy, tar-like product that was brought to the surface. This field's preliminary development occurred simultaneously with the peak of production in the Summerland field. Its spindly wooden derricks at the end of piers jutting out into the Pacific Ocean off the Santa Barbara coast have served to provide illustrations for numerous articles, emblazoned many "wish-you-were-here" picture post cards mailed from California by tourists.

That first period of over-production represented less than 20,000 bbl. daily production. Development of fields that have made history in the California oil business followed through subsequent years. Their names received prominent mention in petroleum, technical, trade and general publications. Sunset, Midway, Whittier, Santa Maria, West Coyote, Salt Lake, McKittrick, Buena Vista Hills, Lost Hills, and North Midway were recorded in the order named, and are still producing—even under curtailment. Each of these discoveries, each of these developments, had its coterie of optimists and pessimists, with the peak of production at less than 250,000 bbl. daily. Over-production? No, merely excess production pending the time when the oil business could find additional markets for its products. Markets were hard to create. Possible fuel oil consumers hesitated about changing over equipment to this cleaner and more efficient fuel. They heard rumors of "threatened shortage" and "higher prices." The "crude petroleum price structure" tottered and fell. Cooperative marketing was discussed and perfected. A truce on development was agreed upon, and persisted through the latter part of 1910 and early 1911.

Increased fuel oil demands, the rapid development of the internal combustion engine, and demands for motor fuel, again stimulated activity. New fields were discovered and production of known fields reached their peaks during the period 1911-1914, with another call for cessation of drilling. The World War and its demand for California oil and oil products maintained production—with some slight increase during the period 1914-1918—which brings us to the period covered by the chart, beginning in 1919, with an average uncurtailed daily production approximating 280,000 barrels.

Conditions somewhat similar, politically, to those now present and persistent, had been developing for several years, with the result that the first serious labor disturbance in the industry occurred in 1921, graphically shown as bringing the state's production to a five-year "low" approximating 225,000 barrels daily. Over-production, lack of demand, large stocks in storage, radical labor leadership and inequitable demands, all combined to defeat this short-lived strike. With its end, the California oil industry entered a period of industrial peace that has lasted for 12 years, experienced its greatest development and maximum production. There were times during these years when the industry employed in excess of 60,000 workers.

Beginning with the year 1922, and persisting through the greater part of 1923, the chart shows conclusively and dramatically that estimates theretofore made of petroleum reserves were and had been hopelessly inadequate as a measure



Service Rendered...

is the ultimate measure of quality in sucker rods

It therefore becomes necessary for the sucker rod manufacturer to determine and provide for all the elements that contribute to utmost serviceability.

He has at his disposal a choice of steels; and competent advice as to what alloy agents contribute to definite, desirable qualities in the steel, as well as to the undersirable ones. If it is his desire to prevent deterioration of the rods by corrosion, he may add nickel, molybdenum, or chromium to the steel. If he wishes to guard against brittleness, he will judge carefully the maximum amount of manganese and carbon used. If he considers ductility a salient quality, he also will control those elements which might contribute to high yield and high ultimates but which, at the same time, tend to lower ductility and increase brittleness.

Good sucker rod steel also possesses additional qualifications. It must be clean steel from the metallurgist's viewpoint---free from foreign materials that are detectable only under the microscope. It should not have seams or other physical defects, which indicate carelessness in the first processes of manufacture. It should have a comparatively smooth surface that can result only from careful rolling in the steel mill. It should be of uniform diameter, and should range high in those tests that indicate ductility and lack of brittleness.

D + B Superloy Sucker Rods embody in the highest degree the merits listed above. Their high nickel content efficiently serves to effectively retard corrosion fatigue; and the addition of molybdenum assures a fine grained, shock resisting steel, insuring the ultimate in service.

"QUALITY FIRST"
D+B
TRADE MARK

D + B Superloy Sucker Rods are distinguished by the distinctive marking on the pin end of each rod, as illustrated.

D + B PUMP & SUPPLY COMPANY

Dallas, Texas Division of Emsco Derrick & Equipment Company **Los Angeles, California**

All D + B Products Distributed Exclusively in the Mid-Continent by Continental Supply Company

11 Vital Reasons Why

GUN PERFORATOR SERVICE

Is Safe—Positive—Economical

1. Positive Perforation

Perforation thru as many as three strings of casing cemented together, proves complete, positive perforation under the most difficult conditions.

2. Exact Depth Assured

A positive depth indicator, electrically operated, insures a safe, accurate method for perforating in accordance with logs or surveys, even when the oil-bearing stratum is narrow and bounded on one or both sides by water. The danger of human error, always possible when stringing or measuring in, is thus avoided.

3. Accurate Spacing of Perforations

The mechanism which controls vertical movement of the Gun Perforator, the visible depth indicator, and the firing switch all are grouped in the control compartment of the truck, so that the "shooter" at all times has exact knowledge of the position of the Gun, over which he has complete control. By merely depressing the firing switch at the instant the depth indicator reading coincides with the desired depth shown on his firing chart, perforations are made exactly where specified.

4. No Distortion of Casing

The high velocity at which the round, hardened steel bullet penetrates the casing produces a clean, round hole without any tendency to bulge or split the casing.

5. Time Saving

The perforator fires from 10 to 15 shots per run. The shots are fired one at a time, by electric current controlled by the "shooter." The discharge of the shots occurs instantaneously with the closing of the firing switch. The original setup of equipment at the well requires approximately one hour. Each round trip, including the discharge of 10 to 15 shots at a depth of 5,000 to 6,000 feet occupies about 40 minutes. Time for testing and replacing discharged chambers on the surface between runs averages 15 minutes. The actual speed of operation can be visualized from the recent "shooting" of 1400 perforations in one well at an average depth of 8,000 feet in a total elapsed time of 73 hours while the well was full of liquid.

6. Complete Equipment

Each service unit consists of a fully equipped truck carrying its own line, winch, sheave assembly and generator. The customer need furnish only a line on which to suspend the sheave assembly. The unit is manned by an experienced "shooter" and a competent derrick man, who require only the assistance of a two-man crew at the well.

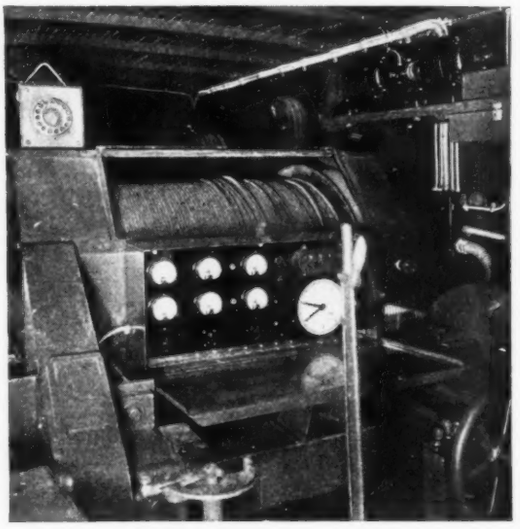
7. Safety

After the contacts of the unloaded gun have been tested, the generator which supplies the direct current for firing, is never started until the loaded gun has been lowered into the well to the desired depth. Absolute safety on the derrick floor is thus assured and all danger of perforation other than at the specified depth is eliminated.

8. Maximum Penetration

Gun perforation has proven successful through such combinations as 6⅝" cemented in 8⅝", cemented in 10¾"; 6⅝" cemented in 9", cemented in 13" hole; 5¾" cemented in 8⅝"; and 4¾" cemented in 6⅝", cemented in 7⅝" hole. Repeated tests have resulted in penetration of several feet of virgin soil after the bullet had passed through as many as three strings of casings cemented together.

Gun Perforator Service Unit



"Shooter's" Controls in Truck

9. Positive Results in Over 450 Wells

The best evidence of success and satisfaction is found in Gun Perforation of more than 450 wells for over 130 different oil companies.

10. Many New Applications

Perforating for special cementing jobs, and perforating blank liners which have been cemented in place without breaking up the cement are only two of many new applications possible with Gun Perforator Service.

11. Standard Sizes

Gun Perforators are available in the following sizes: 3⅜" OD 12 shot; 4½" OD 15 shot; 5¼" OD 10 shot. All Guns fire a bullet measuring .47" in diameter to produce a hole in A.P.I. grade casing which "mikes" approximately .45".

Our Engineers are always available to discuss your perforating problems — at your office or ours — without any obligation.

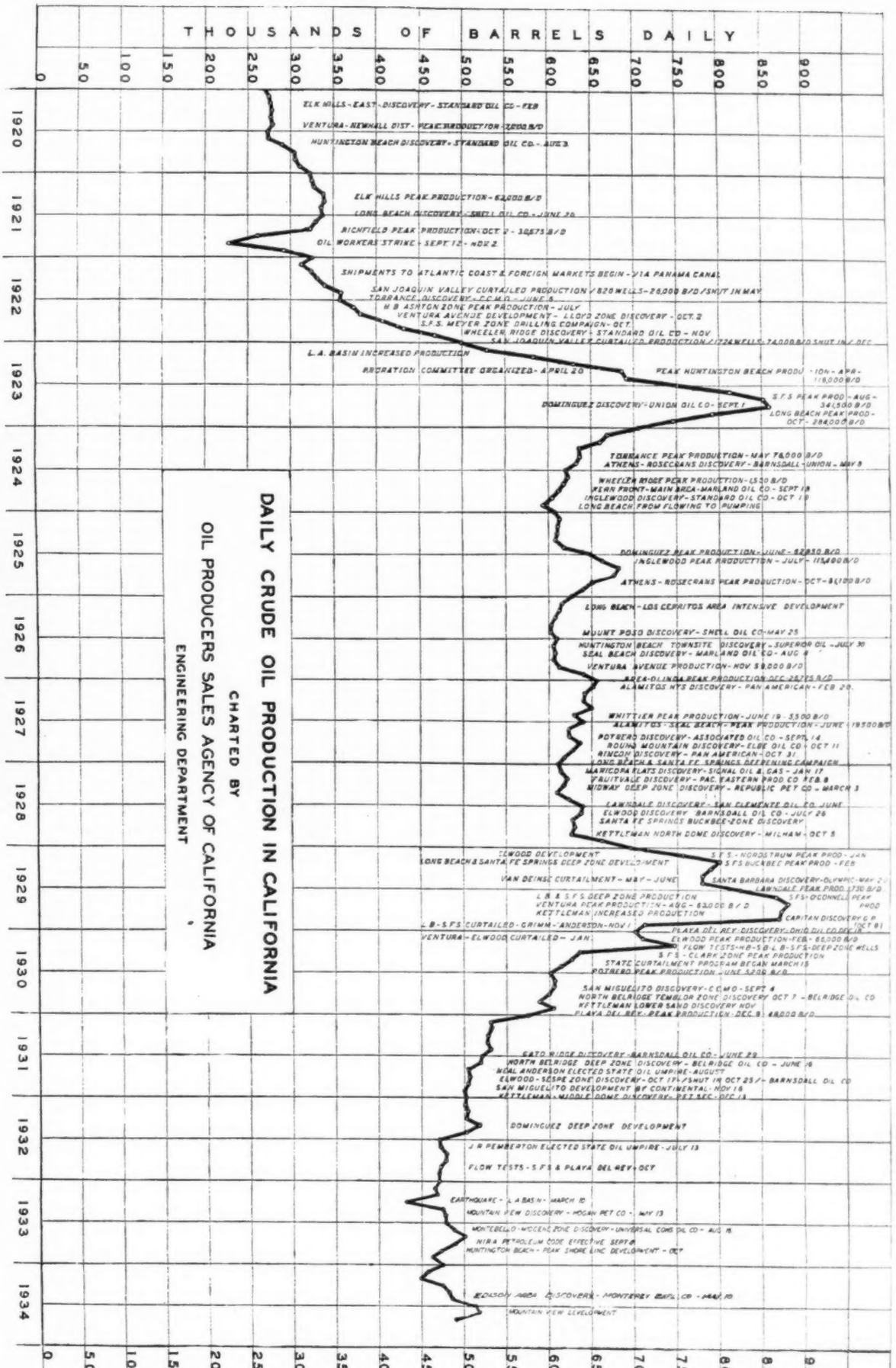
THE LANE-WELLS CO.

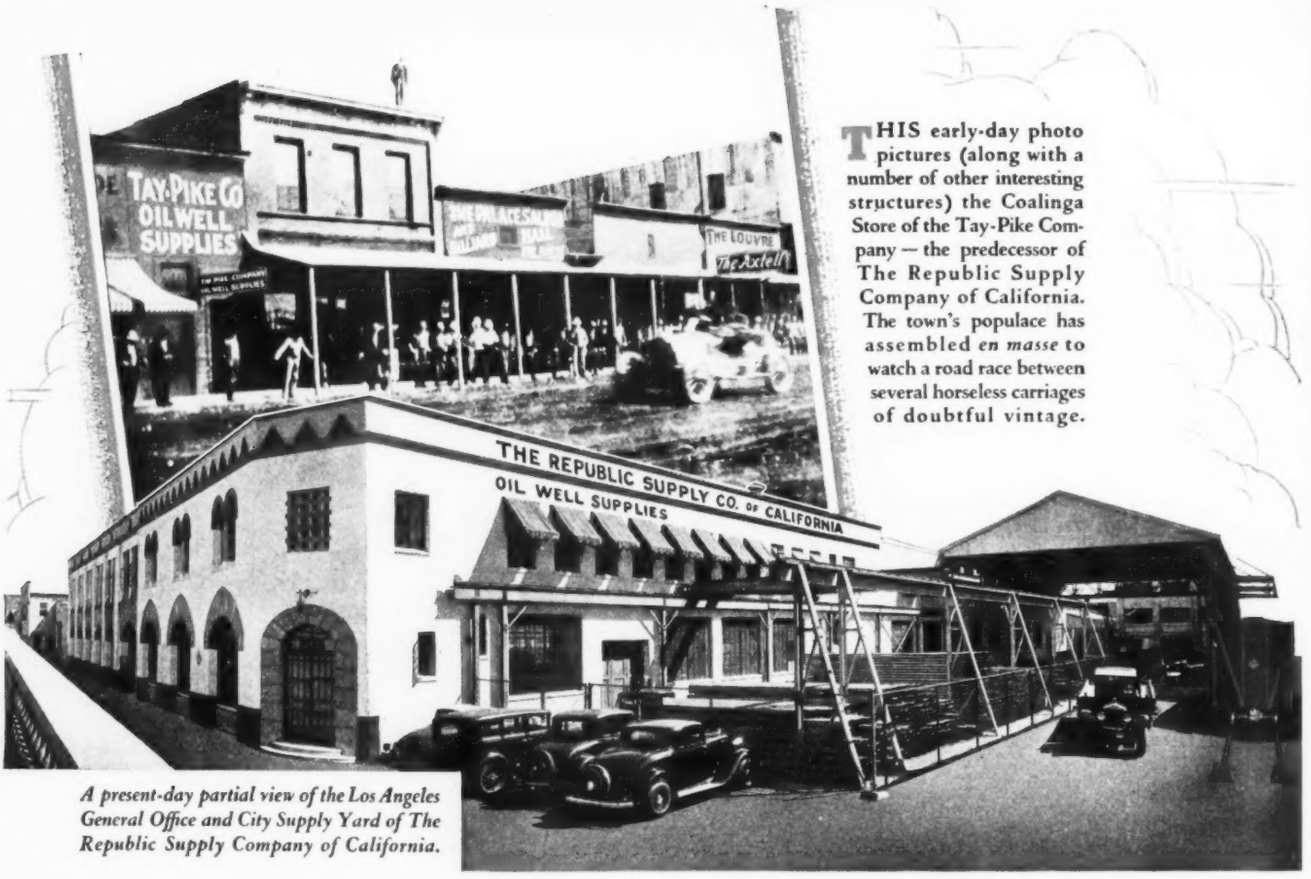
Tomorrow's Tools -- Today!

ON THE PACIFIC COAST:
Telephone JEfferson 5289
4439 Santa Fe Avenue
Los Angeles, California

Fully Protected by Patent No. 1,582,184, and other patents pending

ON THE GULF COAST:
CApitol 1044
1315 Palmer Street
Houston, Texas


DAILY CRUDE OIL PRODUCTION IN CALIFORNIA
CHARTED BY
OIL PRODUCERS SALES AGENCY OF CALIFORNIA
ENGINEERING DEPARTMENT
THOUSANDS OF BARRELS DAILY
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
ELK HILLS - EAST - DISCOVERY - STANDARD OIL CO - FEB
VENTURA - NEWHALL DIST - PEAK PRODUCTION - 12000 B/D
HUNTINGTON BEACH DISCOVERY - STANDARD OIL CO. - AUG 3
ELK HILLS PEAK PRODUCTION - 63,000 B/D
LONG BEACH DISCOVERY - SHELL OIL CO. - JUNE 23
RICHFIELD PEAK PRODUCTION - OCT 2 - 30,675 B/D
OIL WORKERS STRIKE - SEPT 12 - NOV 2
SHIPMENTS TO ATLANTIC COAST & FOREIGN MARKETS BEGIN - VIA PANAMA CANAL
SAN JOAQUIN VALLEY CURTAILED PRODUCTION V 820 WELLS - 26,000 B/D / SHUT IN MAY
TORRANCE DISCOVERY - C C M O - JUNE 5
W B ASHTON ZONE PEAK PRODUCTION - JULY
VENTURA AVENUE DEVELOPMENT - LLOYD ZONE DISCOVERY - OCT. 2
S.F.S. MEYER ZONE DRILLING CAMPAIGN - OCT.
WHEELER RIDGE DISCOVERY - STANDARD OIL CO - NOV
SAN JOAQUIN VALLEY CURTAILED PRODUCTION / 1724 WELLS - 74,000 B/D SHUT IN / DEC
L.A. BASIN INCREASED PRODUCTION
AGITATION COMMITTEE ORGANIZED - APRIL 20
PEAK HUNTINGTON BEACH PRODU - ION - APR - 118,000 B/D
DOMINGUEZ DISCOVERY - UNION OIL CO - SEPT 1
S.F.S. PEAK PROD - AUG - 341,500 B/D
LONG BEACH PEAK PROD - OCT - 294,000 B/D
TORRANCE PEAK PRODUCTION - MAY 76,000 B/D
ATHENS - ROSECRANS DISCOVERY - BARNSDALL - UNION - NOV 9
WHEELER RIDGE PEAK PRODUCTION - 1,530 B/D
PEARL FRONT - MAIN AREA - MARLAND OIL CO - SEPT 18
INGLEWOOD DISCOVERY - STANDARD OIL CO - OCT 19
LONG BEACH FROM FLOWING TO PUMPING
DOMINGUEZ PEAK PRODUCTION - JUNE - 82,850 B/D
INGLEWOOD PEAK PRODUCTION - JULY - 113,400 B/D
ATHENS - ROSECRANS PEAK PRODUCTION - OCT - 81,100 B/D
LONG BEACH - LOS CERRITOS AREA INTENSIVE DEVELOPMENT
MOUNT POSO DISCOVERY - SHELL OIL CO - MAY 25
HUNTINGTON BEACH TOWNSITE DISCOVERY - SUPERIOR OIL - JULY 30
SEAL BEACH DISCOVERY - MARLAND OIL CO - AUG 4
VENTURA AVENUE PRODUCTION - NOV 53,000 B/D
AREA - OLINDA PEAK PRODUCTION DEC 28,775 B/D
ALAMITOS NO 1 DISCOVERY - PAN AMERICAN - FEB 20.
WHITTIER PEAK PRODUCTION - JUNE 19 - 5,500 B/D
ALAMITOS - SEAL BEACH - PEAK PRODUCTION - JUNE - 19,500 B/D
POTRERO DISCOVERY - ASSOCIATED OIL CO - SEPT. 14
ROUND MOUNTAIN DISCOVERY - ELBE OIL CO - OCT 11
RINCON DISCOVERY - PAN AMERICAN - OCT 31
LONG BEACH & SANTA FE SPRINGS DEEPENING CAMPAIGN
MANICOPA FLATS DISCOVERY - SIGNAL OIL & GAS - JAN 17
FRUITVALE DISCOVERY - PAC. EASTERN PROD CO FEB 8
MIDWAY DEEP ZONE DISCOVERY - REPUBLIC PET CO - MARCH 3
LAWNDALE DISCOVERY - SAN CLEMENTE OIL CO. JUNE
ELWOOD DISCOVERY BARNSDALL OIL CO - JULY 26
SANTA FE SPRINGS BUCKBEE-ZONE DISCOVERY
KETTLEMAN NORTH DOME DISCOVERY - MILHAM - OCT 5
ELWOOD DEVELOPMENT
LONG BEACH & SANTA FE SPRINGS DEEP ZONE DEVELOPMENT
S.F.S. - NORDSTRUM PEAK PROD - JAN
S.F.S. BUCKBEE PEAK PROD - FEB
VAN DEINSE CURTAILMENT - MAY - JUNE
SANTA BARBARA DISCOVERY - OLYMPIC - MAY 2
LAWNDALE PEAK PROD. 1,730 B/D
L.B. & S.F.S. DEEP ZONE PRODUCTION
VENTURA PEAK PRODUCTION - AUG - 63,000 B/D
KETTLEMAN INCREASED PRODUCTION
S.F.S. - O'CONNELL PEAK PROD
CAPITAN DISCOVERY G.P. (OCT 8)
L.B. - S.F.S. CURTAILED - GRIMM - ANDERSON - NOV 1
PLAYA DEL REY - DISCOVERY - OHIO OIL CO. DEC 18
VENTURA - ELWOOD CURTAILED - JAN.
ELWOOD PEAK PRODUCTION - FEB - 86,000 B/D
FLOW TESTS - H-B - S.B. & B-S.F.S. - DEEP ZONE WELLS
S.F.S. - CLARK ZONE PEAK PRODUCTION
STATE CURTAILMENT PROGRAM BEGAN MARCH 15
POTRERO PEAK PRODUCTION - JUNE 5,200 B/D
SAN MIGUELITO DISCOVERY - C C M O - SEPT 4
NORTH BELRIDGE TEMBLOR ZONE DISCOVERY OCT 7 - BELRIDGE OIL CO
KETTLEMAN LOWER SAND DISCOVERY NOV
PLAYA DEL REY - PEAK PRODUCTION - DEC 9 - 48,000 B/D
GATO RIDGE DISCOVERY - BARNSDALL OIL CO - JUNE 29
NORTH BELRIDGE DEEP ZONE DISCOVERY - BELRIDGE OIL CO - JUNE 16
NEAL ANDERSON ELECTED STATE OIL UMPIRE - AUGUST
ELWOOD - SESPE ZONE DISCOVERY - OCT 17 - SHUT IN OCT 25 / - BARNSDALL OIL CO
SAN MIGUELITO DEVELOPMENT BY CONTINENTAL - NOV 16
KETTLEMAN - MIDDLE DOME DISCOVERY - PET SEC - DEC 13
DOMINGUEZ DEEP ZONE DEVELOPMENT
J R PEMBERTON ELECTED STATE OIL UMPIRE - JULY 13
FLOW TESTS - S.F.S. & PLAYA DEL REY - OCT
EARTHQUAKE - L.A. BASIN - MARCH 10
MOUNTAIN VIEW DISCOVERY - HOGAN PET CO - MAY 13
MONTEBELLO - MIOCENE ZONE DISCOVERY - UNIVERSAL CONS OIL CO - AUG 15
NIRA PETROLEUM CODE EFFECTIVE SEPT 9
HUNTINGTON BEACH - PEAK SHORE LINE DEVELOPMENT - OCT
EDISON AREA DISCOVERY - MONTEREY SHALE CO - MAR 10
MOUNTAIN VIEW DEVELOPMENT



THIS early-day photo pictures (along with a number of other interesting structures) the Coalinga Store of the Tay-Pike Company — the predecessor of The Republic Supply Company of California. The town's populace has assembled *en masse* to watch a road race between several horseless carriages of doubtful vintage.

A present-day partial view of the Los Angeles General Office and City Supply Yard of The Republic Supply Company of California.

We join the swelling chorus:

"CALIFORNIA INVITES THE A. P. I."

LOS ANGELES
BAKERSFIELD
MOUNTAIN VIEW
TAFT • AVENAL
VENTURA • ELWOOD
HUNTINGTON BEACH
SANTA FE SPRINGS
LONG BEACH
THENARD

—to hold its 1935 Annual Meeting in Los Angeles

YOU were last here in 1926 . . . eight years ago! That's a long time between visits. We . . . all of us . . . want you here in 1935. If you come, California will outdo herself to please. There will be much to see and much to do, we assure you.

THE REPUBLIC SUPPLY COMPANY OF CALIFORNIA

of either crude petroleum that might be produced or the ability of developers in this industry. Beginning with 1922, "offshore demand" served to stimulate development activities. Further new discoveries were made, notably in the coastal and Los Angeles Basin areas, while older fields reached their peak production periods. Curtailment of production was again attempted, but met with limited success. The state's production curve had climbed to a hitherto unprecedented level, and stopped in 1923 at its maximum over the years—in excess of 860,000 bbl. daily.

Notwithstanding these new discoveries, decline curves had their effect, and a period of more or less settled production prevailed—between 600,000 and 700,000 bbl. daily—combined with intermittent efforts to develop satisfactory methods for some form of voluntary production curtailment. Varying degrees of success met these efforts; however, it was not until the discoveries of the Kettleman North Dome in the San Joaquin Valley, the Elwood field on the coast, and deep zones in the Los Angeles Basin, threatened to disrupt the industry that operators generally became receptive to the curtailment idea.

A somewhat abortive effort toward state-wide curtailment was made in May-June, 1929. The failure of this effort is attributed by some to a lack of understanding of national conditions by the majority of the operators. Others blame assumed authority to issue orders, and tactlessness in administration. Whatever may have been the cause, the movement did not succeed, and the production curve exceeded its previous peak, with a daily average production of 878,000 bbl., and again the crude petroleum price structure weakened to a degree that threatened complete collapse.

Previous attempts to bring about some form of state-wide voluntary production curtailment—as has been noted above—had either failed miserably, succeeded partially for but limited periods of time, or never got beyond the conversation stage. Early in 1930, however, a movement began that received the tentative approval of the majority of the independent oil producers. From this movement developed the voluntary effort to provide state-wide curtailment and equitable proration of crude petroleum production that has demonstrated greater efficacy than state laws—or even the militia. The obvious success of this effort is graphically delineated on the state's production curve. Its proponents and exponents had neither the backing of law, interference by government—national or state, or dictatorship in any form. It was purely voluntary, controlled by elected committees selected by the operators, and persisted to the promulgation of the Petroleum Code.

With acquiesence in that Code by the industry, the machinery provided by the California oil operators to curtail and prorate was absorbed by government and still officiates, continuing to register and record accomplishments by voluntary effort rather than from dictation. Potential production of the state has remained at more than a million bbl. daily throughout the period of both voluntary and governmentally-supervised curtailment.

This graphic portrayal of crude petroleum production history in California is a practical refutation of the oft-times threatened shortage of oil. As noted, a number of times in the history of the oil industry in this state, there have been periods of over-produition, followed by renewed demand that taxed the resources of the industry. Political opportunists seized upon such conditions to urge "conservation" but always under government control. Technical men were found willing to issue profound studies estimating the—usually—limited life of reserves. In fact more oil has been produced in California, and more is potentially proved and available, than has been at times indicated as even being in existence. The political-minded seek public approval of their desire to control—or even acquire—industries, through the stimulation of threat of shortage.

The subject of reserves, however, is largely a matter of opinion and mainly of conjecture, with few petroleum engineers sufficiently informed to issue forecasts, unless hedged about with convenient qualifications to prevent future discredit.

To the oil operator, however, threatened shortage is wholly supplanted by his continuous fear of the development of a substitute for petroleum and its products that will make it unnecessary for him to bring to the surface his hard-won reserves of crude petroleum, compelling him to so readjust his business that other outlets may be found, or to enter a field of business made available by science using other sources of raw material.

The history of alleged conservation measures provides ample illustrations of competing materials and substitutes that restrict use of the material originally conserved. The opinion has been rather freely expressed that neither the public—nor the oil men—desire restrictions of a type that will prevent free and unhampered use of this natural resource—petroleum—as it is needed.

In conclusion, it might be said that some of the drama, much of the history, and most of California's crude petroleum production facts, are contained in this small chart. Attempt has been made to correlate them, briefly, to the end that those unfamiliar with the situation in California may have gained some slight knowledge. A further attempt has been made to present the usual dry-as-dust figures in a manner to arouse interest, with the full understanding that other oil-producing states may have had equally as glamorous a background.

Professor Peter Oleum

. . . from an old wood cut made during the last A.P.I. meeting in California, at which time he vowed not to shave until this annual meeting was again held in his native state.

THE PROFESSOR TODAY—with apologies to the Smith Brothers—anxiously awaiting news from Dallas. You can help to restore this man to respectability. Both his family and his barber urge your consideration of this sad case.

Now...BAROID offers an improved mud testing service AT YOUR WELL!

. . . . You'll find these specially equipped cars in every active oil field!

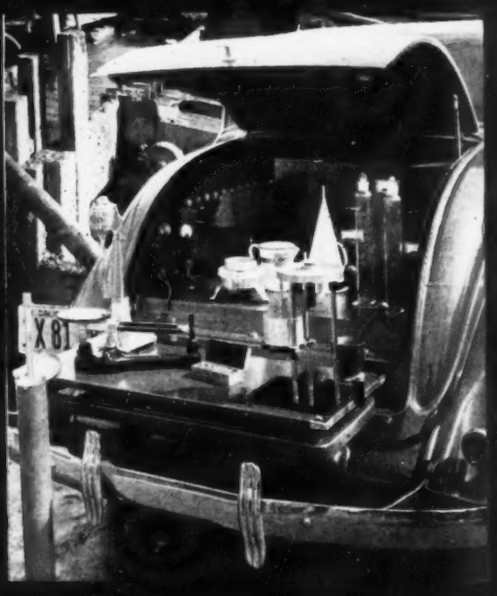
BAROID ★ AQUAGEL ★ STABILITE

A Complete Drilling-Mud Service

BAROID, AQUAGEL and STABILITE have been recognized for years as highest-quality mud conditioners.

In keeping with this quality—*we now provide an even greater service!*

Be sure to take advantage of this service. Get in touch with the BAROID Service Engineer in your vicinity. His tests and recommendations mean freedom from drilling mud troubles.



BAROID PRODUCTS

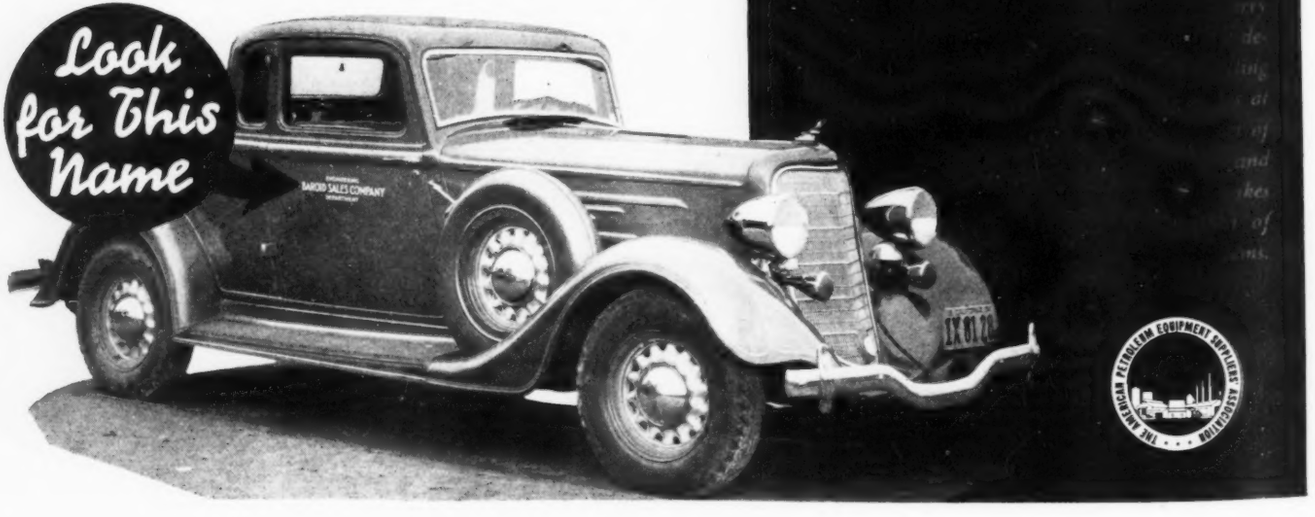
BAROID . . . . . Extra-Heavy Colloidal Drilling Mud
AQUAGEL . . . . Trouble-Proof Colloidal Drilling Mud
STABILITE . . . An Improved Chemical Mud Thinner

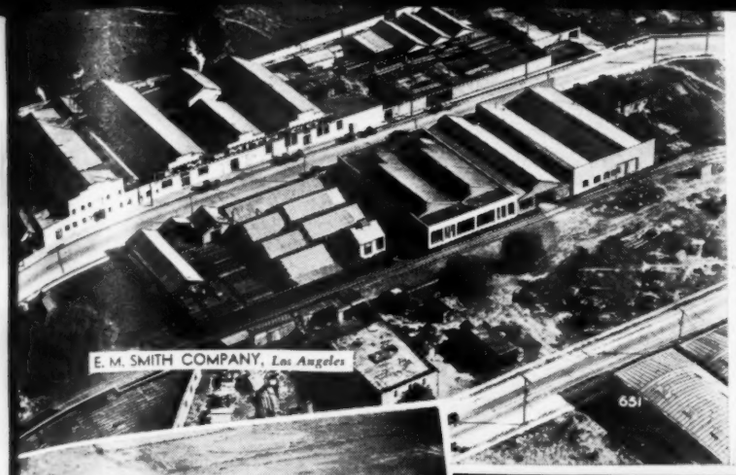
BAROID SALES CO.

LOS ANGELES • HOUSTON

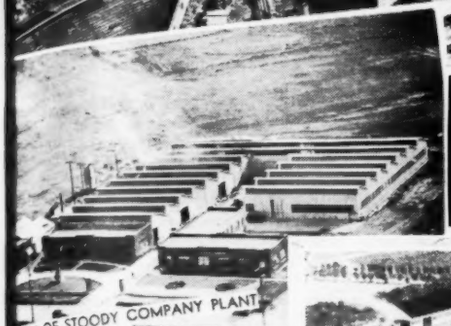
National Pigments & Chemical Co., St. Louis

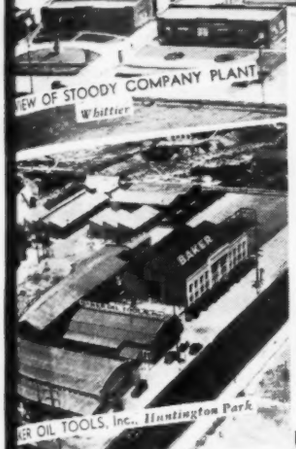
Look for This Name




E. M. SMITH COMPANY, *Los Angeles*

KOBE, Incorporated, *Huntington Park*


VIEW OF STOODY COMPANY PLANT
Whittier



ER OIL TOOLS, Inc., *Huntington Park*

THE NATIONAL SUPPLY COMPANY OF CALIFORNIA
UNION TOOL DIVISION, *Torrance*

BAASH-ROSS TOOL COMPANY, *Los Angeles*

McCLATCHIE MANUFACTURING CO.
Compton

POMONA PUMP COMPANY, *Pomona*

SOUTHWESTERN ENGINEERING COMPANY PLANT, *Los Angeles*

SPECIALTY OIL TOOL COMPANY, *Brea*

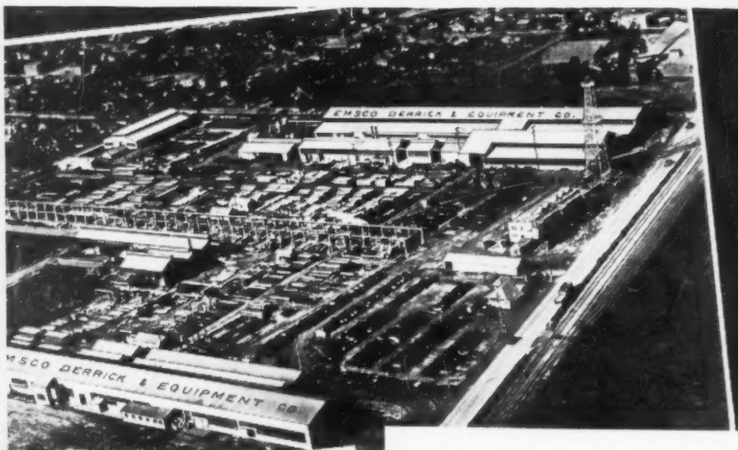
SECURITY ENGINEERING CO., *Whittier*

LOS ANGELES GENERAL OFFICES AND CITY SUPPLY YARD OF THE REPUBLIC SUPPLY COMPANY OF CALIFORNIA

BAROID SALES COMPANY'S LOS ANGELES PLANT

PLANTS OF SOME OF CALIFORNIA'S PETROLEUM EQUIPMENT MANUFACTURERS, AMONG THE MOST PROGRESSIVE IN THE WORLD

SALES OFFICE OF OIL WELL SUPPLY COMPANY, *Los Angeles*



EMSCO DERRICK & EQUIPMENT CO., *Los Angeles*

GLOBE OIL TOOLS CO., *Los Angeles*

J. P. RATIGAN, Manufacturer, *Los Angeles*

ELLIOTT CORE DRILLING COMPANY, *Los Angeles*

S. R. BOWEN CO. *Huntington Beach*

THE HEWITT-KUSTER CO., *Long Beach*

MAIN PLANT AND OFFICE OF FLUID PACKED PUMP COMPANY, *Los Angeles*

OIL FIELD SPECIALTIES WITH A REPUTATION

•

REPUBLIC
Electric Weld Line Pipe
Electric Weld Slip Joint
Surface Casing
Toncan Copper Molybdenum
Iron Pipe

•

ELECTRUNITE
Boiler Tubes

•

TUBE TURNS

•

HARRISBURG
Forged Steel Flanges and Bull Plugs

•

WALWORTH VALVES
and Fittings

•

VICTAULIC
Flexible Pipe Couplings

•

At Your Service

DUCOMMUN CORP.

Los Angeles • San Francisco

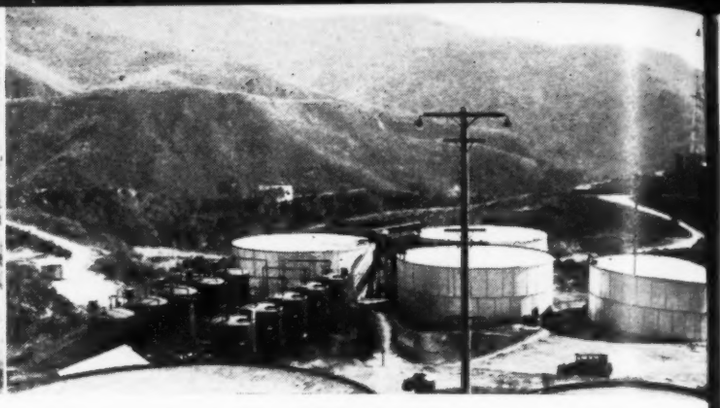
OUT in CALIFORNIA IT IS *JUST AN OLD SPANISH CUSTOM* TO CALL **PACIFIC** ON THE "TOUGH" CEMENTING JOBS...

After years of experience, our organization of expert cementers — with a detailed knowledge of field conditions — realizes that the cementing of each oil well is an individual problem. • Modern power equipment makes it possible to utilize this experience in "whipping the tough jobs." The many easy ones which follow are proof of our belief that oil men are not only square shooters but that they appreciate the painstaking, conscientious effort necessary for successful cementing.

PACIFIC OIL WELL CEMENTING COMPANY, LTD.

Long Beach · Los Angeles · Bakersfield

A battery of separators handling production from a group of wells in the Ventura Avenue field



An electrical dehydration plant in California

CALIFORNIA CONTRIBUTES MUCH TO DRILLING AND PRODUCTION PRACTICES

By
WALLACE A. SAWDON
Petroleum Engineer
Los Angeles

FOR many years California has been the proving ground in the development of equipment design and operating methods. It has thus contributed a great deal to the advancement of both drilling and production technique and, due to the subsurface conditions encountered, has presented problems which, in their solution, have provided methods and tools that have since become of universal use throughout the oil industry. This is especially true in regard to deep drilling; and since even deeper drilling and a greater development to depths already reached can well be expected, further advancements in the application of engineering principles will be made by operations in this state.

Interest throughout the entire oil world has naturally been focused on the depth records made in California during the past few years. These records, however, have been far more important than the mere demonstration that the depths attained could be drilled. They have shown, with increasing evidence in each well, that planned operations, the utilization of methods and devices for drilling control, and the present design of most equipment will drill to depths now conceived as necessary with minimum hazard and reasonable assurance of success.

The deepest well in the world, General Petroleum Corporation's Berry No. 1, in the South Belridge field, aptly demonstrated the value of coördination among the management, technical staff and the drilling crew. In drilling this well, the operations were planned and all methods of drilling control followed. With but few exceptions, the equipment used was of conventional design and not all of it was the heaviest type available. The result was an 11,377-ft. well drilled with the minimum hazard and almost a negligible amount of shut-down time due to fishing or subsurface trouble.

Drilling Control

Speed in drilling is naturally a desirable factor. Yet speed in drilling when accompanied by crooked hole, fishing jobs and a generally bad subsurface condition of the well is not so desirable. Considerable experimental work has been conducted by many of the oil companies in California during the past year to provide drilling control that will assure the maximum speed of drilling with the minimum hazard and straightest hole. The control of weight on the bit has, for a long time, been a means of keeping the hole straight and the cutting tools efficient. To increase drilling efficiency, however, other factors can be coördinated with weight control.

Valuable data have already been procured on the effect of speed of rotation on drilling speed, on tools and equipment and on the character of the hole obtained. While no general conclusions have been made, there is now a tendency to increase the speed of rotation to obtain better results; and of greater importance, to control this speed and coördinate it with the weight being carried on the bit.

The torque on the drill pipe has also come in for attention. The power required to turn the pipe naturally is a factor in drilling control; but its regulation is also a means of preventing trouble.

The drilling fluid, of course, is a matter of great importance in deep drilling. It requires especial attention in California, since mud with the necessary characteristics is not always readily available in many of the fields. Considerable study has been and is being made on mud control. The use of different kinds of admixtures to meet different conditions is necessary—with proper colloidal properties most important at some times and great weight at others. Constant attention to conditioning of the mud fluid and to pump pressure is especially important in deep wells where proper circulation may be hampered by restricted space. In the case of the Berry well mentioned above, the mud materials were not only carefully selected and blended, but a special device was used to measure the weight of the drilling fluid at all times and to determine its sediment content and rate of settling.

The surveying of wells was developed in California and has probably been used to a greater extent here than at any other place. During the past few years, wells have been kept straight during drilling by periodic measurements of both the inclination and direction of deviation; and corrective measures are generally taken before the hole has had a chance to get very far from the vertical.

Coring

The value of information relative to subsurface formations in well completion and in providing geological data has been well recognized and has probably increased the amount of coring being done. The percentage of core re-

The Eastman Method of Controlled Directional Drilling*

Removable Whipstock
Patent No. 1,970,761

We first survey the well, which gives us the necessary information about what is wrong and what is needed to correct it. Next we set a removable whipstock. Then a single-shot survey is run and we check the results. By surveying often, carrying an up-to-date survey plan, and running deflecting tools when needed, it is relatively easy to complete the job with satisfactory results.

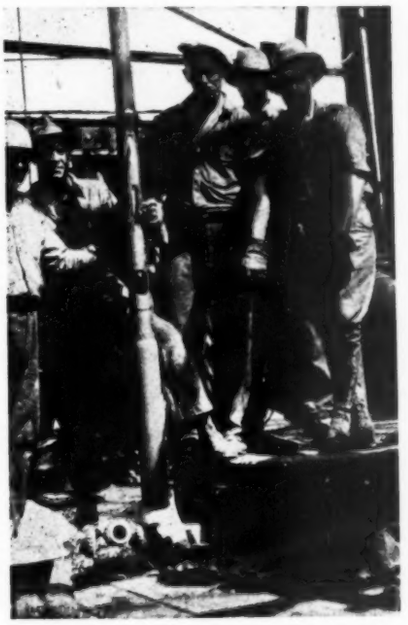
Single-Shot Actual Size

*Submit Your Problems. Our Controlled Directional Drilling Service Is Saving Operators Thousands of Dollars.

EASTMAN
OIL WELL SURVEY CO. OF TEXAS

4909 Fannin Street, Houston » Also Lake Charles, Louisiana
Oklahoma » Eastman Oil Well Survey Co. « Oklahoma City
California » H. John Eastman « Long Beach

CONTROLLED DIRECTIONAL DRILLING
OIL WELL SURVEY SERVICE



Successful Fishing Jobs Like This Are Common Occurrences With

THE CAVINS

Here is actual evidence showing how effectively The CAVINS recovers junk and cuttings of every description from oil wells. The illustrations were made from unretouched photographs of a well in Southern California. The material shown consists of three complete cones weighing 8 pounds, and 150 pounds of additional iron and steel cuttings. It was recovered in just a few hours, enabling the crew to make hole again without delay.

The CAVINS is without a peer for reconditioning wells, fishing, bailing, and washing perforations. Write for illustrated folder.

Illustration made from unretouched photo shows crew that used The CAVINS to recover more than 150 pounds of junk from one well in just a few hours.

THE CAVINS COMPANY

2853 Cherry Avenue Telephone 414-14
Long Beach, California, U.S.A.
R. J. EICHE, *Export Manager*
Branches or Representatives at:
Oklahoma City, Okla. Houston, Texas
Shreveport, La. McPherson, Kans.
Bakersfield: 3808 Chester Ave. Telephone 1779-J
Taft: 401 Supply Row. Telephone 226
Goleta: Telephone 834-92
Santa Paula: 525 Main St. Telephone 234

covery has increased during the past few years, and this is due not only to improvements in design of coring equipment but also to a better use of the core barrel by drilling crews. Successful coring has been done in the hardest of formations and at the greatest depths. The deepest core naturally came from the Berry well and was eight ft. in length, taken below 11,000 feet.

Probably the greatest obstacle to deep coring will be caused by small diameter holes. The core mentioned above was made in a 5⅝-in. hole and in a formation that was very hard. In the previous record depth well, the Lillis & Welch No. 1 in Kettleman Hills, cores taken below 10,000 ft. were also in 5⅝-in. hole. There would seem to be no trouble, therefore, in getting good cores from any depth in a 5-in. hole. In cases where the hole size has to be reduced, it is doubtful if any more difficulty will be experienced in coring than in straight drilling. Core recovery will probably be as great as in the same size hole at shallower depths, since the core size and character of formation have more to do with the percentage of core recovered than do other factors influencing deep drilling. Considerable data in regard to rotary coring at great depths will undoubtedly be accumulated within the next few years in California, since there is every reason to believe that many wells will be drilled nine or ten thousand feet to production during this period. The Associated Oil Company's well, Lloyd No. 83, in the Ventura Avenue field has been producing at but little less than 10,000 feet. More wells at about this depth in this field and others below 9000 feet in the Kettleman Hills field will probably be drilled to production when the necessity arises.

Equipment

Numerous wells in California have demonstrated the efficiencies of different types of bits for different formation drilling. Drill pipe has stood up remarkably well; and by utilizing care and due attention to drilling control, twist-offs have been cut down to a minimum. The use of flush joint pipe has aided materially in deep wells and has been found particularly advantageous in providing adequate circulation under certain conditions.

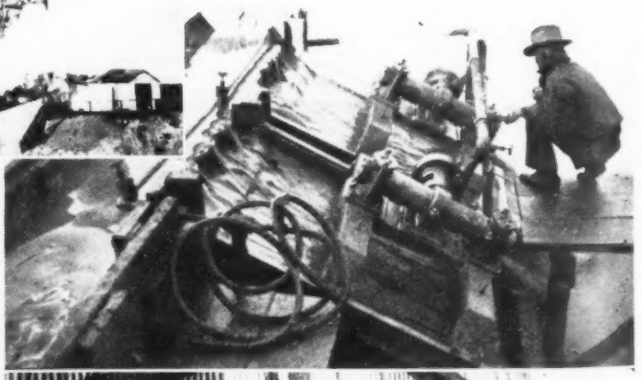
Many record strings of casing have been run in wells throughout the state. The extra strength provided by Grade "D" pipe has probably been necessary in many instances. Some strings have been so long that the factor of safety of collapse strength has often been reduced to a very low figure. Proper cementing to a point high enough above the shoe, however, has eliminated practically all danger. The strain due to tension is kept well within safe limits by floating the string into the hole by the use of float collars.

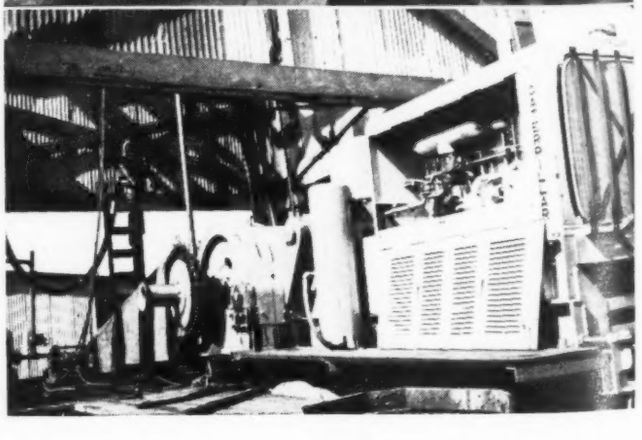
Surface equipment, both for drilling and for production, is selected with care at all times. The heaviest drilling equipment is not always used for the deepest wells. Some of these wells have been drilled with comparatively light equipment; but the tendency is to use the most modern designs. High pressure control gates, blow-out preventers and fittings have become the rule where any possibility of high pressures is expected; and in the case of deep wells, pressures equal to the hydrostatic head are customarily provided for.

Conservation

In addition to the curtailment program that is being carried out with a success not equaled by some other parts of the country, many conservation measures are being carried out conscientiously by many of the companies where conditions do not make their operation a hardship. What is in all probability the most nearly complete—and certainly the most successful—unit plan of operation in the country is being conducted at the North Dome of Kettleman Hills.

The Kettleman North Dome acreage is controlled almost entirely by the Kettleman North Dome Association and the Standard Oil Company of California. The coöperation between these two organizations has made possible orderly and planned drilling and regulated production with an aim toward higher ultimate yield from the entire productive area. The only fly in the ointment is that a few operators with some small holdings have not come into the Kettleman North Dome Association and have caused a few wells to be drilled at a time and place not conducive to the best interest of the development of the field as a whole. Had this field been thrown open to uncontrolled drilling like many another field in the country, the wasting of gas, the dissipation of lifting power and the flood of oil would have been a tragedy.





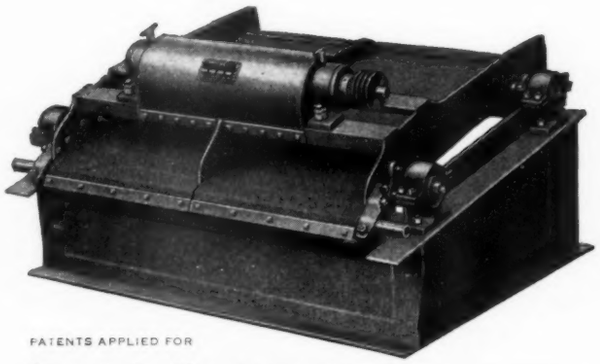
Left: The tallest derrick ever used was installed to drill a well in the Ventura Avenue field.

Below: Vibrating screens have aided materially in keeping the drilling fluid in condition.

Bottom: A large portable hoist used for redrilling operations. Note guard on rotary drive chain. Some of these machines will drill wells to 4000 feet.

McNEELY VIBRATING SCREEN

With CURVED SURFACE ... for Reclaiming Rotary Mud



PATENTS APPLIED FOR

THIS highly perfected yet simplified screen features: **1**—A curved screen surface which facilitates the *rapid* disposal of waste cuttings; **2**—A vibrating force which is transmitted *equally* to all parts of the screen, eliminating dead spots, and, **3**—A compact and sturdy, all-steel, unit type of construction which saves ground space and head room, and makes installation and removal easy.

VERNON TOOL CO., Ltd.
2740 E. 37th ST., LOS ANGELES, CALIFORNIA

Memo to the **A.P.I.:**

In company with every member of California's Oil Industry, we invite consideration of Los Angeles for your 1935 Annual Meeting. A most hearty welcome awaits you!

ASK FOR NEW CATALOG NOW

An eight page, illustrated catalog—just off the press—will give you complete information on the McNeely Vibrating Screen. Ask your supply house for a copy, or write direct.

WHY RETURN THE CUTTINGS TO THE HOLE?

A Cordial Invitation
To The American Petroleum Institute

Urging that Los Angeles be selected as the scene of the 1935 Convention, is extended by Mr. Edward L. Doheny, Chairman of our Board of Directors. Members will find many of their friends in the Oil Industry located in our Office Building at 10th and Flower Streets, Los Angeles.

PETROLEUM SECURITIES COMPANY

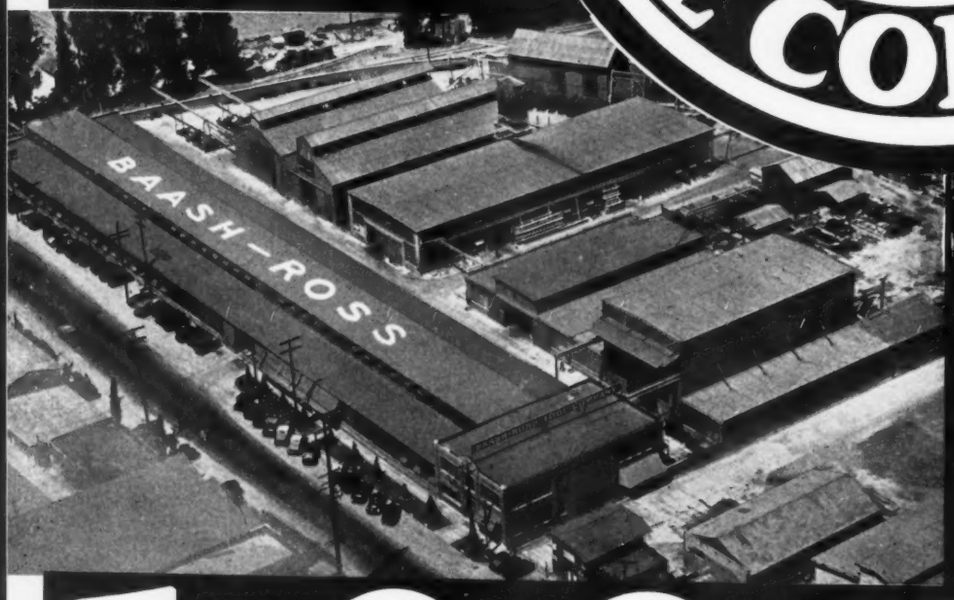
15 years

1919

Of working, learning, serving are behind the steady growth of

BAASH-ROSS TOOL COMPANY

B-R



1934

DURING these fifteen years the oil well drilling art has progressed nearly to the point of being a science. Baash-Ross has contributed many times to this progress.

BAASH-ROSS TOOL COMPANY

Telephone 3-4406
1559 S. E. 29th St.
OKLAHOMA CITY

Telephone Hadley 6676
1301 Maury Street
HOUSTON

Telephone 599
BEEVILLE
TEXAS

Gulf Coast Distributors: NORVELL-WILDER SUPPLY CO.

General Offices: 5512 Boyle Ave., Los Angeles, Calif. • *Export Offices:* 30 Church Street, New York, N. Y., U. S. A.

Book Reviews

Oil and Petroleum Year Book. Compiled and published by Walter E. Skinner, 15 Dowgate Hill, Cannon Street, London, E. C. 4, England, (1934). 458 pp. Price 7s. 6d. net; or post free (domestic) 8s. 0d., (foreign) 8s. 6d.

The book contains particulars of 673 English and foreign companies—producers, refiners, dealers, transporters and oil finance companies, including the principal American and foreign companies. Lists are also given of the officials connected with the companies and comprise 2,586 directors, 342 secretaries and 202 consulting engineers, managers, agents, etc., their names and addresses and company connections.

The particulars of each company include the directors and other officials, date established, location of property or description of business, purchase consideration, oil production capacity of refineries, capital, dividends and financial position as disclosed by latest accounts.

Other useful features of the book are the statistical tables showing the world's production of crude petroleum for the nine years ended December, 1933, the monthly production for 13 months ended April 30, 1934, of the principal British companies, list of 574 trade names of petroleum products marketed by the various companies and a glossary of nearly 500 technical terms and words peculiar to the oil industry.

* * *

The Chemical Formulary. Vol. I. Editor-in-Chief, H. Bennett. Published by The Chemical Formulary Company, 950 Third Avenue, Brooklyn, New York (1934), 604 pages.

The Chemical Formulary is a condensed collection of valuable, timely, practical formulae for making thousands of products in all fields of industry. It is designed to bridge the gap between theory and practice and is for the use of chemists, engineers, technical workers, purchasing agents, executives, instructors, sales managers, etc. Over 40 industrial chemists, professors and technicians in many branches of industry have co-operated to make this book possible.

* * *

The Engine Indicator. By K. J. DeJuhasz, assistant professor of engineering research, Pennsylvania State College. Instruments Publishing Company, 330 West 42nd Street, New York, N. Y. (1934), 240 pp., 300 illus. Price $2.00 postpaid.

The purpose of this book is to present the history, theory and construction of the many forms of the pressure indicator from its inception to the present day. In its pages the author gives a modernized treatment of modern indicators for the users of high-efficiency steam and internal combustion engines developed since 1914.

Information contained in this 240-page book is valuable not only for engineers in power plants, pumping stations, truck and bus fleet shops, engine factories and automotive and aeronautical research laboratories, but for all engineers who have to investigate forces and motions, and particularly for those who may have no interest in engines but who are concerned with variable pressures.

* * *

World Petroleum Directory. Published by Russell Palmer, 56 West 45th Street, New York City. 644 pages. Price, $10.00.

The 1934 edition of the World Petroleum Directory covers the oil companies of the entire world, listing producers, refiners, marketers and jobbers, pipe line and transport operators, natural gasoline manufacturers, giving complete information regarding directors, officers, personnel, subsidiaries, history, capital structure, dividends, detailed information concerning properties and financial reports for 1933 as well as quarterly reports for 1934. It also contains an up-to-date list of oil associations, asphalt manufacturers and producers of liquefied petroleum gases. A special section is devoted to United States marketers and jobbers of petroleum products, arranged by states. Oil companies operating outside of the United States have been segregated by continent and country in order that the data may be easily obtained. The edition also contains a list of refiners of the world, arranged by states and countries. Chart of Soviet petroleum industry shows the producing, refining, marketing and pipe line properties. This section also contains a list of the directors of the Soviet trusts. The book is completely cross-indexed, making it easy to locate any information desired. Copies may be obtained by addressing this publication or World Petroleum Directory.

H. K. Browning Heads Sales Force of The S. M. Jones Company

The S. M. Jones Company, Toledo, Ohio, manufacturers of sucker rods, announces the appointment of H. K. Browning as manager of sales.

H. K. BROWNING

Browning was formerly with the A. M. Byers Company, manufacturers of wrought-iron products. He started with the company in 1925 as sales engineer, first in Chicago and later in Kansas City. In 1926 he was made Kansas City district manager and the following year division manager for both the St. Louis and Kansas City districts. In 1930 he was transferred to San Francisco to take over the entire west coast activities of Byers. In 1932 Byers reorganized their sales, to the petroleum industry, on a national scale and Browning was moved to Pittsburgh as manager of oil sales. He held that position up to the time of his recent appointment as sales manager for The S. M. Jones Company.

Joe Fuller Handling New Account

Joe Fuller has been appointed North Texas, Louisiana and Arkansas representative for France Packing Company, Tacony, Philadelphia, Pennsylvania. France packing will be handled in addition to his regular lines, Fast Couplings and American Hammered piston rings, the former being manufactured by Bartlett-Hayward Company, Baltimore, Maryland, and the latter by American Hammered Piston Ring Company of the same city. Fuller's headquarters are in Fort Worth, Texas.

L. M. Klinedinst Elected to Timken Board

Directors of The Timken Roller Bearing Company on October 30 elected L. M. Klinedinst to the board and also promoted him to the office of vice-president in charge of sales to fill the vacancy created by the recent resignation of Judd W. Spray. Klinedinst has been associated with The Timken Company for 29 years. He has been vice-president in charge of all industrial sales since 1930.

T. V. Buckwalter, who has been vice-president of The Timkin Roller Bearing Company for several years, was elected vice-president and director of The Timken Steel & Tube Company.

because OVERLOADING *destroys* WIRE ROPE

Know your Ropes . . . This is a helpful hint, how to make wire rope last longer. Subsequent Wickwire Spencer advertisements in this publication will give other dollar saving information. Tell us about your rope problem and we will give you the answer.

Extraneous conditions, often unknown to the user of wire rope, may cause overloads . . . and overloading is the greatest single destroyer of Wire Rope. It crystallizes the wires within the rope and always results in premature failure. The use of a tension meter will tell you your rope story. When loads are known it is easy to select the "right" rope to give maximum efficiency on that particular job. Let the Wickwire Spencer engineer give you helpful information about the tension meter and its uses. Write us.

●

WICKWIRE SPENCER STEEL COMPANY, New York City, Buffalo, Chicago. Worcester; *Pacific Coast Headquarters:* San Francisco; *Warehouses:* Portland, Los Angeles, Seattle. *Export Sales Dept.,* New York City.

WIRE ROPE *by Wickwire Spencer*

BOTH . . . STANDARD LAY AND WISSCOLAY PREFORMED.

Wickwire Spencer manufactures all sizes and types of Wire Rope in standard lays and preformed. Wisscolay preformed wire rope will often solve a wire rope application difficulty. Ask our engineers where and when it should be used. Send for a free WIRE ROPE BOOK. It will prove of great value.

Engineering Fundamentals Department

- A Study Course for Field and Plant Men
- A Review for Experienced Engineers

W. L. NELSON
● K. C. SCLATER ●
Editors

Elements of Applied Petroleum Production

Article 13

EQUIPMENT AND OPERATION OF OIL WELLS (Continued)

By K. C. SCLATER

PUMPING WELLS—Continued

VOLUMETRIC EFFICIENCY. The volumetric efficiency of a pump is the ratio of the volume of liquid pumped to the displacement of the pump. In the case of a regular reciprocating oil well pump the displacement is the length of stroke through which the pump plunger travels times the area of the plunger multiplied by the number of strokes. A convenient formula used by Marsh[62] to calculate the pump displacement in bbl. per day is as follows:

$$D = S \times N \times C$$

where:

D = displacement in bbl. (42 U. S. gal.) per 24-hr. day
S = length of stroke in inches
N = number of strokes per minute
C = coefficient (values of C for common sizes and types of pumps in use are given in Table 4).

The coefficients C given in Table 4 are obtained as follows:

$$C = \frac{a \times m}{v}$$

where:

a = area of plunger in sq. inches.
m = 1440 (the number of minutes in 24 hours).
v = 9702 (the volume of one bbl. in cu. inches).

For example, a 2-in. A.P.I. cast-iron liner pump has a plunger of 1.75 in. diameter or an area of approximately 2.405 sq. inches.

To find the value of coefficient C we then have:

$$C = \frac{2.405 \times 1440}{9702}$$

or $C = 0.357$

In deep wells the actual length of the plunger stroke is not the length of stroke at the polished rod. Due to tubing stretch and rod stretch the plunger stroke is rarely, if ever, equal to the polished-rod stroke. Calculations of volumetric efficiency sufficiently accurate to have any practical value cannot therefore be based on polished-rod stroke.

Theoretical calculations of tubing and rod stretch to arrive at the actual plunger stroke in deep wells are quite involved and, as was noted in last month's article, become more so as the pumping speed is increased. In the paper just referred to, Marsh[62] gives five methods, including formulas and tables of coefficients, for estimating the actual plunger stroke in deep wells under different pumping conditions. In discussing Marsh's paper Coberly[62, 63] also presents a method for determining the overtravel.

Other positive methods of determining plunger travel are sometimes resorted to, such as by noting the wear on the barrel or by the use of a marker attached to the top or bottom of the plunger. The limitations and possible errors entering into such practical methods are outlined by Marsh[62] as follows:

"The trouble is that both length of stroke and average position of plunger vary from time to time. When the rods are first run into a well, they are at atmospheric temperature, but gradually approach the subsurface temperature as oil from the formation is pumped into and through the tubing. A difference of temperature of only 50 deg. will cause the length of a 4000-ft. string of rods to change 16 inches. If appreciable wear of the barrel takes place before the temperature reaches equilibrium, the worn length of the barrel will be greater than the length of any one stroke. In the case of an 8000-ft. well having an average temperature of 150 deg., and with an atmospheric temperature of 50 deg., the error due to temperature alone might be as much as 64 inches.

"Changing loads on the plunger due to increasing fluid level in the tubing and decreasing fluid level in the casing may also make large errors. For example, assume a 4500-ft.

well with a 2-in. tubing, pumping 20-deg. A.P.I. liquid. It can be computed that while the length of plunger stroke with tubing empty is the same as the polished rod stroke, 40 in., the net stroke after the tubing is filled will be only 21.8 inches. As this decrease of stroke will be gradual, it is apt to be impossible to distinguish the wear representing normal stroke from that representing original stroke. Moreover, in some cases the increased sucker rod stretch at the end of the upstroke, due to the tubing being full, may be less than the increased stretch of the tubing, so that the plunger will be working higher in the barrel. Thus, wear due to normal stroke with full tubing will extend beyond the wear due to greater stroke with empty tubing, and the error will be increased by the amount of this extension. This latter situation occurs in the case of small diameter pumps with large tubing. It may be calculated theoretically, and its existence has been indicated by inserted pumps becoming unseated by the pump 'bumping up' as the tubing becomes filled."

Another source of error that may enter into the determination of volumetric efficiency of pumps in deep wells is the possible change in volume of the oil between the pump and the surface. An appreciable change in volume may result from expansion due to the reduction of pressure, and also from shrinkage due to the release of gas in solution and temperature changes. Caution should therefore be exercised to see that the determination of the volume of oil pumped is reasonably accurate.

TABLE 4
Coefficients for Computing Pump Displacement

Type of Pump A.P.I. Standards	Nominal Size of Pump	Actual Plunger Diameter	Coefficient "C"
Cast-Iron Liner - - - - -	2-in.	1.750 in.	0.375
Cast-Iron Liner - - - - -	2½-in.	2.250 in.	0.590
Cast-Iron Liner - - - - -	3-in.	2.750 in.	0.882
Regular Cold-Drawn Barrel	2-in.	1.781 in.	0.370
Regular Cold-Drawn Barrel	2½-in.	2.250 in.	0.590
Regular Cold-Drawn Barrel	3-in.	2.750 in.	0.882
Regular Inserted - - - -	2-in.	1.500 in.	0.262
Regular Inserted - - - -	2½-in.	1.781 in.	0.370
Regular Inserted - - - -	3-in.	2.250 in.	0.590

Many deep pumping wells have gas in solution in the oil under pressure. As the oil rises in the tubing the gas comes out of solution and assists in lifting the oil to the surface.

Wells that still have a good supply of gas energy, which if properly utilized might be made to prolong the flowing life, are sometimes placed on the pump. Such wells may flow naturally part of the time they are assumed to be pumping, with the result that the pump will show a very high volumetric efficiency that is apparent rather than real.

It can be seen, therefore, that the volumetric efficiency of an oil well jump may be a very indeterminate thing, particularly in wells having much gas with the oil. The volumetric efficiency of a pump, however, increases in importance during the later stages of a well's life when little or no gas is present with the oil and when pumping economies are most needed.

Experience indicates that volumetric efficiencies between 50 and 75 per cent may be attained in the average well.

Besides pump displacement, other factors affecting the volumetric efficiency of pumps are gas-lock, pump slippage, and valve leakage. A rarer factor contributing to poor efficiency is tubing leakage. Of these, the pump displacement, which should be such as to fit the well conditions,[64] involves a consideration of pumping speeds and loads. In deep wells a reduction in pumping speed is usually desirable. Rod loads are taken care of by using a pump of as small a diameter as is consistent with the rate of production desired. The determination of these factors is usually more involved, for example, than the problems encountered in overcoming mechanical troubles such as pump slippage and valve leakage. With regard to these last-named mechanical defects, Marsh[62] says: "It appears probable that leakage through pump valves is a more common source of excessive loss than slippage past plungers. Leakage of valves in good condition is negligible, but leakage through moderately worn valves is excessive."

Both pump slippage and valve leakage can be determined by inspection and tests at the surface.

Editor's Note—In last month's article, under the discussion on sucker rods on page 39 (October issue) the sentences:

"They are usually made of special alloy steel and each rod carefully heat-treated throughout. Under modern methods of manufacture the better class of sucker rods are upset on the end rather than welded."

. . . should be changed to read as follows:

"They are usually made of special alloy steel and each rod carefully subjected to some kind of heat-treatment* either on the ends or throughout. Under modern methods of manufacture the ends (pins or boxes) of the better class of sucker rods for deep-well pumping are formed either from machined and heat-treated forgings electric-welded to the rod or from a head upset on the end of the rod rather than welded."

---

*Heat-treatment is used here in a general sense and may mean "normalizing" or "heat-treating," or both.

In explanation of these two terms, "normalizing" and "heat-treating," it perhaps should be pointed out that:

Sucker rods may be heat-treated to remove the forging strains and restore the original structure of the metal or they may be heat-treated to improve the physical properties of the metal.

The former heat-treating process, which generally consists of controlled heating and air-cooling, is really an annealing process, and is known as "normalizing."

The latter process, heat-treating to improve the physical properties of the metal, consists of controlled heating, quenching in water or other liquid, and then drawing the temper. This process is usually referred to as "heat-treating."

QUESTIONS

1. What is the volumetric efficiency of an oil well pump? How is it calculated?
2. Why is the actual plunger stroke in a deep pumping well so hard to determine?
3. What practical method or methods might the field man use to estimate the actual plunger travel in an oil well pump?
4. What are some of the drawbacks and possible errors against using such a practical method or methods?

REFERENCES

[62] "High Volumetric Efficiency in Oil Well Pumping and Its Practical Results," by Hallan N. Marsh—A.P.I. *Production Bulletin* 207, 1931.

[63] "Solving Well-Pumping Equipment Problems," by H. Ledeen, *The Petroleum Engineer*, p. 39, March, 1933.

[64] "The Proper Diameter Pump for the Oil Well," by Austin Allen, Jr.—A.P.I. Division of Production, Mid-Continent District Meeting, Wichita, Kansas, February 17-18, 1933.

4½ YEARS CONTINUOUS SERVICE NO MAINTENANCE EXPENSE●

WHAT LUFKIN MEANS BY ★ *Continuity of Service with Minimum Expense*

[redacted]

PRODUCING DEPARTMENT

[redacted]

September 6, 1934

Lufkin Foundry & Machine Co.,
Lufkin, Texas.

Gentlemen:-

Following is information concerning a Lufkin Unit, which we purchased from you a little over four years ago:

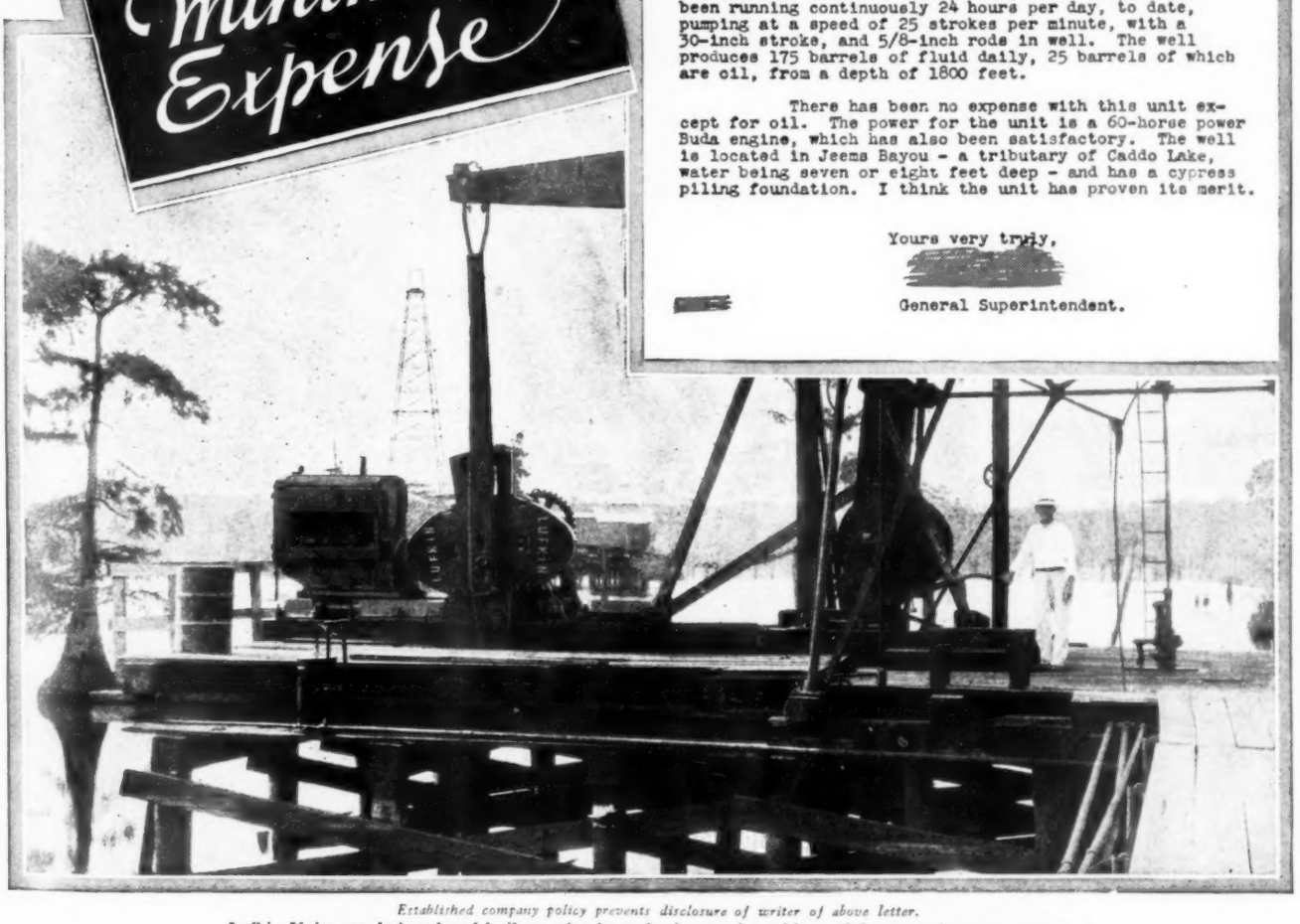
A 4½ worm-gear Lufkin Unit, bought and installed in April 1930 [redacted] J.J. Hart Well No. 19, Caddo Parish, has been running continuously 24 hours per day, to date, pumping at a speed of 25 strokes per minute, with a 30-inch stroke, and 5/8-inch rods in well. The well produces 175 barrels of fluid daily, 25 barrels of which are oil, from a depth of 1800 feet.

There has been no expense with this unit except for oil. The power for the unit is a 60-horse power Buda engine, which has also been satisfactory. The well is located in Jeems Bayou - a tributary of Caddo Lake, water being seven or eight feet deep - and has a cypress piling foundation. I think the unit has proven its merit.

Yours very truly,

[redacted]

[redacted] General Superintendent.



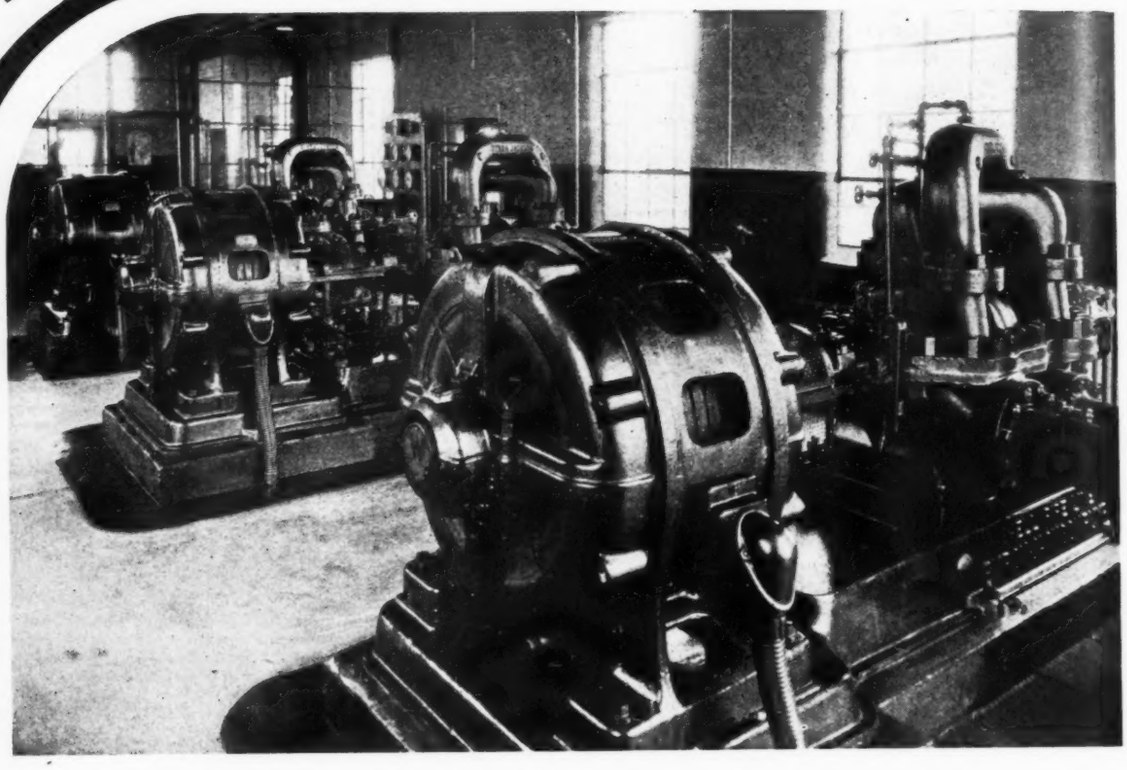
Established company policy prevents disclosure of writer of above letter.

Lufkin Units are designed and built to give long, lasting service with a minimum maintenance expense, and as a result enjoy an enviable record of year in—year out performance.

LUFKIN FOUNDRY & MACHINE COMPANY, Lufkin, Texas—*Branches in* Houston, Henderson, Dallas, Tulsa, Los Angeles and New York.

LUFKIN *Pumping Units*

THE ANSWER TO THE OIL INDUSTRY'S PROBLEMS.....



PURCHASED ELECTRIC POWER

The ups and downs of the oil industry in recent years—the periods of flush production from new fields and the temporary shutdowns due to economic or other conditions—have again proved the advantages of purchased electric power for pipe line pumping.

Let us help you with your power problems . . . transportation, refining, producing . . . at any time without the slightest obligation. More than thirty West Texas oil fields are served by our power lines.

TEXAS ELECTRIC SERVICE COMPANY

General Offices: FORT WORTH

Elements of Applied Petroleum Refining

By W. L. NELSON
Consultant*

Article XIII

LUBRICATING OILS

THERE is such a wide variety of heavy oil stocks and so many treatments are used that only a few general operations can be discussed. Oils are treated with acid, filtered through clay in percolation towers, contacted with fine clay at a high temperature, or treated by solvent extraction methods. The Pennsylvanian oils can usually be finished by percolation or contacting without acid treatment but other oils usually require acid treatment.

ACID TREATMENT. Acid treatment is usually conducted in a batch agitator. The procedure of the treatment is usually slightly different for each oil but the following list of operations indicates the steps that may be followed:

Treatment—(1) Water acid—66 deg. Bé. 2-12 lb.; (2) Agitate—½ to 2 hours; (3) Settle—1 to 2 hours—Drain; (4) Acting Acid—66 deg. Bé. 20-60 lb. Often applied in several doses. Settle and drain after each dose; (5) Agitate—1 to 3 hours; (6) Settle—1 to 6 hours; (7) Agitate gently and sprinkle with water until sludge gathers into lumps.

NEUTRALIZATION IN ANOTHER AGITATOR. (8)Spray with caustic—3 to 10 Bé.—Agitate gently until neutral; (9) Spray with hot water; (10) Settle—6 to 15 hours, taking care not to drain much of the emulsion. Often an emulsion is formed that cannot be separated without introducing acid again; (11) Repeat the washing and settling (9) and (10) several times, and occasionally as many as 12 times.

BRIGHTENING. (12) Heat to 120-160 deg. fahr. with steam coils in open vessel; or, (13) Heat and blow with air; or, (14) Agitate with dry sil-o-cel, etc., and filter.

Neutralization with caustic is a troublesome operation because emulsions are frequently formed. Often these emulsions are of such stability that only a repeated acid treatment will cause a separation. For this reason neutralization is being more and more frequently accomplished by the contact process.

CONTACT FILTRATION. Although contacting neutralizes a "sour" or acid-stage oil, it also effectively decolorizes the oil. Clay decolorizes any oil but it is more effective if the oil is in the acid-stage.

The process is practiced at 220 to 650 deg. fahr. but most refiners contact diluted cylinder stocks at 475 deg. fahr. and neutral oils at 300 deg. fahr. The acid-stage oil is mixed with 200 or 200-300 mesh clay and the mixture is heated in a pipestill. The hot oil is then allowed to settle for a short time and the fines (clay dust) are filtered from the oil in Sweatland or similar presses. Sometimes a short percolation filter is used to aid in the removal of the fine clay. Fig. 29 indicates the general equipment in a contact plant.

The more viscous oils, such as cylinder stock, are usually acid-treated and contacted in solution. The solution contains between 50 and 75 per cent of a high initial-boiling-point naphtha. Normally the naphtha has a boiling-range of 160-400 deg. fahr. Dilution is necessary in the subsequent operation of centrifuge dewaxing and it simplifies the handling of the stock during acid-treating and contacting.

TREATING METHODS (Continued)

PERCOLATION. Percolation was the original method of decolorizing lubricating oils and until recently no other method was widely used. The oil is allowed to flow or drain through a vertical chamber filled with 30-60 mesh clay. In general for gravity flow the longer the packed column the greater the bleaching action, the coarser the earth the less the bleaching, and the higher the temperature the less the bleaching. Bauxites and Fullers earth are used almost exclusively. Although the temperature should not be so high that the oil drains through the clay with only a short time of contact, nevertheless, viscous oils must be heated or the rate of percolation will be hopelessly slow.

Regarding the percolation method Funsten[1] says, "Thus percolation permits the manufacture of a wide variety of oils at one time. White oils or petrolatums of varying degrees of refinement can be processed with it equally as well as cylinder oils. Specialties can be made at little, if any, extra cost by selection of proper cuts from the filter stream. Waxes, gasoline, kerosene and furnace oil can be clarified with revivified percolation clay at extremely low cost, since yields are very large in this type of work." Funsten[1] also reports the operating conditions for a 1000-cu. ft. filter as shown in Table 11.

TABLE II

Stock	Saybolt Viscosity	Temp. of Filtration deg. fahr.	Rate of Filtration Bbl. per hour for 1000 cu. ft. filter	Pressure Filtration* Lb./sq.in.
Light Spindles	up to 200/100	80-100	5-25	0-25
Heavy Spindles	200-500/100	100-140	5-15	0-25
Overhead or Residual cylinder stock	100-160/210	160-200	2-10	15-50
Naphtha solution of cylinder stock		100-130	30-50	5-15
Petrolatums	100-160 M.P.	25 over M.P.	5-20	0-15
Waxes	100-160 M.P.	25 over M.P.	5-20	0-15

*Pressures in the higher range are required where 60-90 mesh earth are used.

The stock may be acid-treated before percolation but it is usually neutralized before it enters the filters. The spent clay is washed with naphtha to remove the oil from the clay and after passing steam through the filter for several hours, the clay can be removed by allowing it to flow from the bottom of the percolator.

[1] *Refiner and Natural Gasoline Manufacturer*, p. 201, June, 1934.

*Professor Petroleum Refining, University of Tulsa.

The clay is usually revivified by burning it at a temperature of about 1100-1200 deg. fahrenheit. Reburning decreases the efficiency of decolorizing. The average efficiency of mixed clay that has been burned one to six times, is about 60 per cent. The clay may be burned as many as 40 times in the Nichols-Herreshoff burner but it is usually not economical to burn the clay more than about 12 times.

The hydrocarbons are adsorbed by clay in about the following order: unsaturates, aromatics, naphthenes, and paraffins. However, the hydrocarbons of high molecular weight are adsorbed more readily and this doubtless accounts for most of the decolorizing action. Thus, the specific gravity, viscosity and color of the stream of oil from a percolation filter increases as more and more oil flows through the filter and the first oil will be of much lower gravity, viscosity and color than the parent stock. Resinous and asphaltic substances are actively adsorbed. Little of the sulphur is adsorbed and hence clay-treating is never used for desulphurization.

In general the refiner uses new clay for light-colored low-viscosity oils, and the heavy oils with a darker allowable color are decolorized by the same clay after it becomes unfit for decolorizing the light oils. Thus, the various used clays progress through the plant in a counter-current manner so that new earths meet light colored stocks and the nearly spent clay meets dark colored stocks.

SOLVENT EXTRACTION. Between 1930 and 1934 the viscosity index of motor oils was forcefully brought to the attention of refiners by advertising. These processes were developed in an attempt to produce high viscosity index oils from mixed and naphthene base crude oils. Some of these processes improve the color but the main object is the separation of the low index hydrocarbons from the oil.

Solvent extraction processes are still in the development stage, although a capacity of about 25,000 bbl. per day will soon be in operation and hence they cannot be discussed in detail. Two general types of solvents are used: a single solvent that dissolves either the low or the high index hydrocarbons and two solvents, one of which dissolves the high index hydrocarbons and the other the low index oil. Some of the solvents that have been used are: (1) Sulphur dioxide—also with benzol; (2) Phenol; (3) Dichlorethyl ether (Chlorex); (4) Furfural; (5) Nitrobenzene—also with sulphuric acid; (6) Propane—Crysylic acid; (7) Crotonaldehyde—Acrolein; (8) Aniline oil. References to these processes will be found at the end of this article.

The development of solvent processes tends to destroy the customary marketing system for crude oils, by which some oils are classed as oils for lubricant manufacture. Many oils heretofore considered as unfit for the manufacture of lubricants because of the tar content and because of an unfavorable viscosity index can now be processed by vacuum distillation and solvent extraction for the manufacture of uniform quality lubricating oils.

CLAY PROCESSES FOR DISTILLATES

The Gray Vapor Phase, the Osterstrom Liquid Phase and the Stratford Continuous processes are the outstanding examples of clay processes for treating cracked distillates. They cannot be applied to high sulphur distillates because they remove little, if any, sulphur. They are effective and cheap for many cracked distillates. The principles underlying the three processes are the same. Most of the diolefin and other gum-forming hydrocarbons are removed but the other hydrocarbons are only slightly attacked. Most low sulphur distillates can be successfully treated but the distillates from some California oils have given difficulty with color stability. The vapor phase process is not generally applied to distillates from vapor phase cracking processes because the action is too vigorous and results in the removal of many valuable hydrocarbons such as the olefins. The Osterstrom process was developed to meet this need. The daily capacities that are handled by these processes indicate their usefulness; the Gray vapor phase process, more than 100,000 bbl. per day; the Stratford process, 30,000 bbl.; and the Osterstrom process, 20,000 barrels.

In the Gray process the vapors from the cracking system are taken through towers that are packed with clay. Polymerization occurs and a polymer liquid containing some gasoline, collects in the bottom of the tower. Refer to Fig. 30. The polymers are injected into the bubble tower or evaporator of the cracking system so that the gasoline is recovered and the pure polymer either finds its way into the tar or is recracked. The vapor passes on to the condensers and is a finished product except for sweetening.

Goode[2] reports that the color and gum content of the

[2]*Refiner and Natural Gasoline Manufacturer*, p. 79, December, 1931.

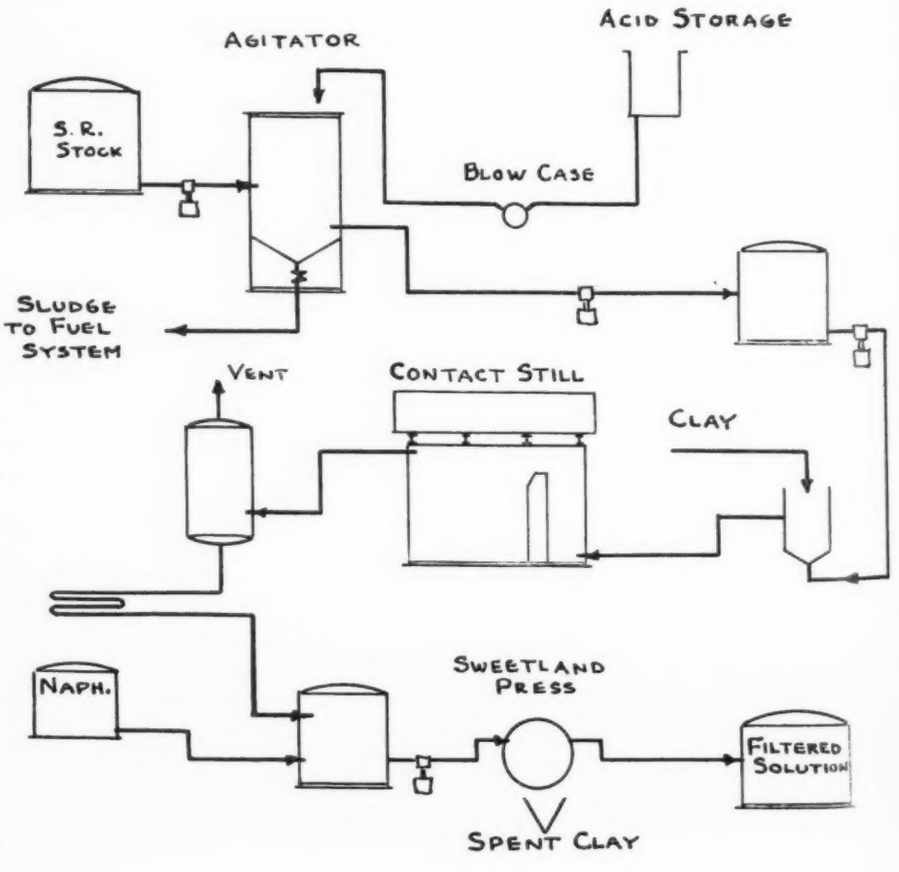
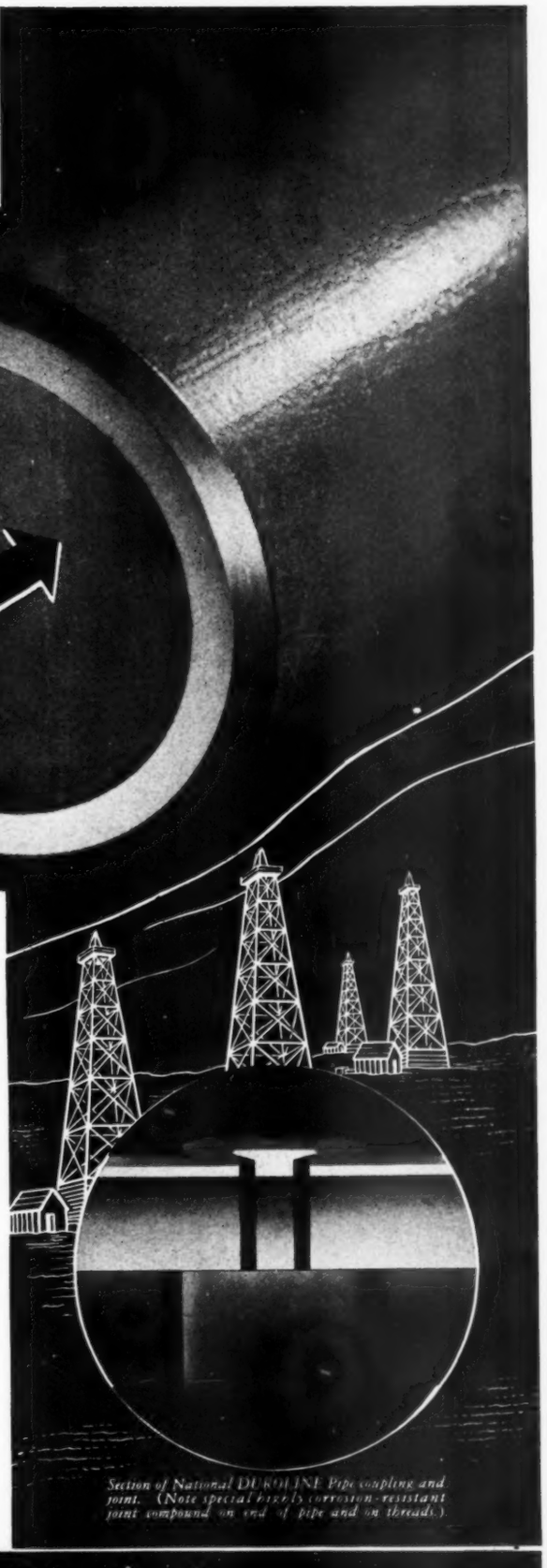


Fig. 29. Diagram of contact process

BRING ON YOUR SALT WATER



DUROLINE PIPE can be specified and installed in salt water disposal systems and gathering lines with assurance that the service rendered will be long and uninterrupted — for tests have proved that salt water has no ill effect on Duroline. This highly protective cement lining was developed primarily to resist the action of certain waters that attack unlined metal pipe. And the cost of this superior combination—NATIONAL full weight steel pipe and special interior lining—is surprisingly low—only slightly higher than regular galvanized pipe.

Further, since Duroline is applied to regular NATIONAL Pipe, you obtain the full strength, full wall-thickness and all other desirable features of the highest quality steel pipe, made by the World's largest maker of tubular steel products, plus this new defense against internal corrosion and tuberculation.

Duroline will help to solve your salt water problems. Outstanding installations are giving added proof every day. An interesting bulletin describes in detail the development of this remarkable product, and its known serviceability! Write for it today.

NATIONAL TUBE COMPANY · Pittsburgh, Pa.
Subsidiary of United States Steel Corporation

Section of National DUROLINE Pipe coupling and joint. (Note special bevels corrosion-resistant joint compound on end of pipe and on threads.)

NATIONAL

gasoline is governed by the vapor velocity and the depth of the bed of clay. Using 30, 15, and 7½ tons of clay in the same tower, he found that the color was 30, 25, and less than 21 for the three charges of clay, and the gum content 25, 33, and more than 74 milligrams. Several refiners have reported that the removal of gum becomes more effective as more and more gasoline vapor is put through the tower. The color of the product decreases slightly as the run proceeds until finally it suddenly becomes very poor and the clay must be removed. The clay may be burned but most refiners feel that it is cheaper not to bother with reburning. A 30-60 mesh clay is commonly used but 60-90 clay is used by some refiners. The following earths have been widely used. Attapulgus, Floridin, Ohmstead (Illinois) and heavy Texas earths.

The throughput per ton of clay is often 3,000-5,000 bbl. and one plant is reported to have processed 20,000 bbl. for each ton of clay. When the Gray process can be used it is certainly an economical and convenient method of treating. The clay chambers range in size from 6 to 16 ft. in diameter and in height from 25 to 40 feet. The only disadvantage of the process is the minor one, that the treating cannot be easily changed or controlled for the production of several grades of gasoline.

In the Stratford process the vapor ascends a treating tower counter-currently to a stream of descending clay slurry. The spent clay slurry is continuously settled in cone bottom tanks and dried continuously with hot flue gas and a vacuum. About 1000 bbl. of distillate can be treated per ton of clay but the gallonage varies because the amount of slurry can be regulated to obtain different degrees of treating. The flexibility of the process is one of its main advantages.

In the Osterstrom process the cracked distillate is heated, as a liquid, in a conventional pipestill to about 500-600 deg. fahrenheit. It flows under pressure (no vaporization) through a bed of adsorbent, such as 30-90 mesh Fullers earth and back into a short coil in the pipestill. It issues from the still at a temperature high enough to cause vaporization when the pressure is released. The vapors are fractionated to end-point in a tower and the polymer is separated as a bottoms product. The high temperature facilitates the action of the clay so that as much as 70,000 bbl. of gasoline can be treated per ton of clay. However, vapor phase gasoline is seldom treated to the high colors that are required in other gasolines.

QUESTIONS

1. Name the four common methods of treating lubricating oils.
2. What is the purpose of solvent extraction?
3. Why is the Gray Vapor Phase process unsuitable for treating vapor phase cracked distillate?
4. Are the adsorption or clay processes used for desulphurization?
5. How does percolation affect the gravity, viscosity and color of an oil?

REFERENCES

Solvent Extraction

[1]Bahlke, Brown & Diwiky, "Chlorex," *Oil and Gas Journal*, p. 60, October 26, 1933.

[2]Ferris, Myers & Peterkin, "Nitrobenzene," *Refiner and Natural Gasoline Manufacturer*, p. 435, November, 1933.

[3]Stratford, Moor & Pokorny, "Phenol," *Oil and Gas Journal*, p. 8, March 30, 1933.

[4]Cottrell, "Edeleanu," *Refiner and Natural Gasoline Manufacturer*, p. 432, November, 1933.

[5]Manley, McCarty & Gross, "Fufural," *Oil and Gas Journal*, p. 78, October 26, 1933.

[6]Poole & Wadsworth, "Crotonaldehyde & Acrolein," *Refiner and Natural Gasoline Manufacturer*, p. 412, November, 1933.

[7]Ziegenhain, "General Development," *Oil and Gas Journal*, p. 44, March 29, 1933.

Lubricating Oils

[8]L. L. Davis, *Refiner and Natural Gasoline Manufacturer*, p. 90, March, 1928.

[9]Nutting, "Commercial Clays," *Ind. Eng. Chem. Annual Ed.*, January, 15, 1932.

[10]Gurwitsch, "Scientific Principles of Petroleum Technology," D. Van Nostrand Co.

[11]Zublin, ". . . Solving Problem for Recovery of Contact Clay," *Oil and Gas Journal*, p. 12, October 27, 1932.

[12]Bertram, "Handling and Rehandling Fullers Earth . . ." *The Petroleum Engineer*, p. 130, September, 1931.

Clay Treating of Distillates

[13]Holland, "Perfect Method for Treating Vapor Phase Gasoline," *Oil and Gas Journal*, p. 22, December 31, 1931.

[14]Mandelbaum & Nisson, "The Life of Fullers Earth used in the Vapor Phase Treatment of Cracked Distillates," *Ind. Eng. Chem.* 18:564, 1926.

[15]Albright, "12000 bbl. Through One Ton of Clay," *Refiner and Natural Gasoline Manufacturer*, p. 71, May, 1931.

[16]Cooke & Hayford, "Distillate Treating I," *Refiner and Natural Gasoline Manufacturer*, March, 1934.

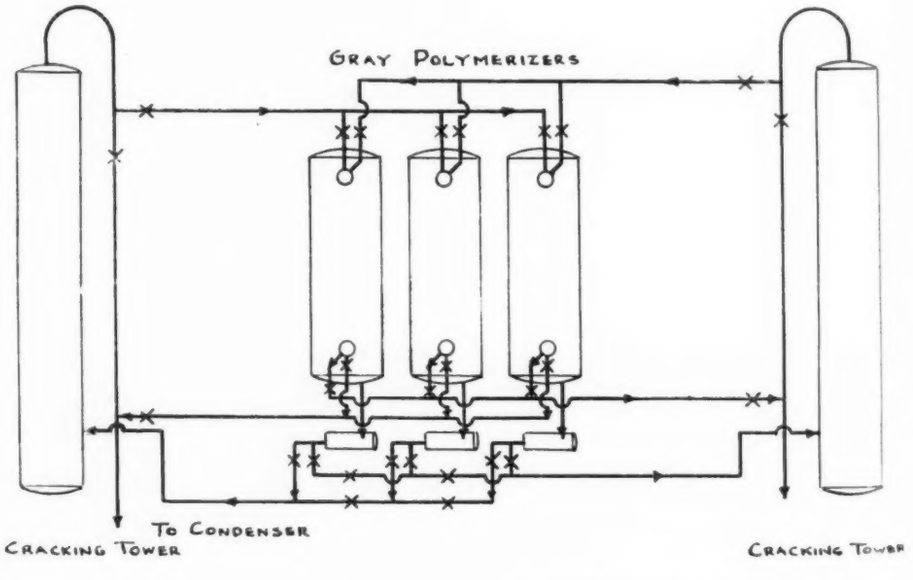


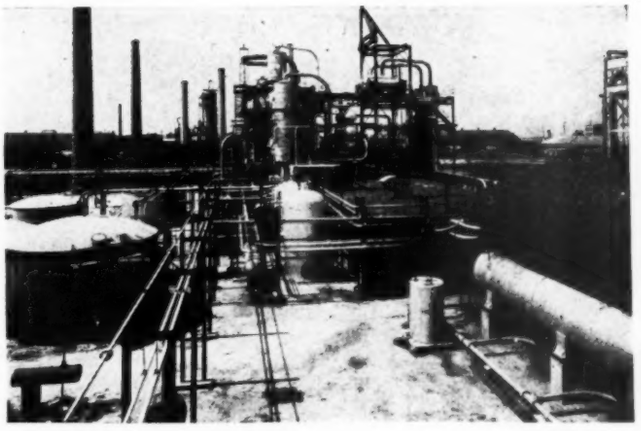
Fig. 30. Arrangement of Gray treating towers

World's *First* Duo-Sol Refinery uses CHAPMAN VALVES *Exclusively*

Max B. Miller and Co., Inc., has built the world's first commercial refinery to use the Duo-Sol process—the advanced method of extracting lubricating oil by using two immiscible solvents. For this new Socony Vacuum Oil Company plant which presents an entirely new set of operating conditions, the designers filled every valve requirement—exactly and economically—with Chapman Valves.

This is not unusual, for Chapman metallurgists constantly study the rapidly changing Oil Industry and develop suitable valves in order to be ready for your next demands. That is why "Chapman" is written into so many refinery and gasoline plant specifications where the valves must stand up under high pressures, intense heat or cold and the effects of corrosion.

If you are building a new plant or modernizing an older one, you will find Chapman ready with the right valves . . . a complete line of gate, globe, angle, and check valves and fittings, in all sizes, for pressures to 1500 pounds and temperatures from 50 degrees below zero to 1000 above. Specify Chapman for every Oil Industry service.

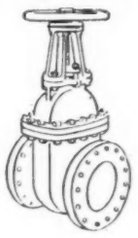


The new Duo-Sol refinery in which Chapman Valves are used exclusively—built for Socony Vacuum Oil Company by Max B. Miller and Co., Inc.

●

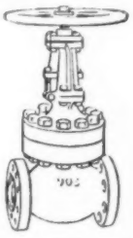
A FULL LINE OF REFINERY VALVES

Chapman Bronze Valves for working pressures to 350 lb.



Chapman Iron Body Gate Valves for 150 lb. pressure

Chapman Forged Steel Globe, Angle and Check Valves for pressures to 1500 lb.



Chapman Cast Steel Globe Valves for pressures to 1500 lb. and temperatures to 1000 degrees

Chapman Chrome Tungsten Steel Gate Valves for corrosive service with pressures to 1500 lb. and temperatures of -50° to 1000° F

Chapman Valves distributed from all principal oil centers

The CHAPMAN VALVE MANUFACTURING CO.

INDIAN ORCHARD, MASSACHUSETTS

Elements of Applied Petroleum Pipe Line Transportation

By EMORY KEMLER
and L. L. THOMAS

Article 4
THE FLOW OF OIL IN PIPES AND PIPE LINES
Part 4—Charts for Parallel Lines

THE working of problems involving parallel lines of the same or different sizes is usually very tedious. The method of analysis, based on Reynolds number, requires that the friction factor be expressed in terms of Reynolds number, in which case the viscosity is seen to enter into the pressure-drop formula. This means that the problem has to be solved for each viscosity of fluid to be used. Furthermore, since the friction factor for the entire range of Reynolds cannot be expressed as a continuous function of R, the formulas have to be worked independently for viscous and turbulent flow. If the charts appearing in this and future issues are used, the problem can be very much simplified. While the pipe sizes appearing in this issue are not normally used for parallel lines, they will be used to illustrate the principle.

Two parallel lines connecting to the same manifold and joining at some given distance must satisfy the condition that the pressure drop in each pipe is the same. To build up a curve for a combination 1-in. and 1¼-in. line carrying oil of 100 Saybolt seconds, we have only to add up the rate of flow at various pressure drops and plot the new rate of flow against pressure drop. On one of the charts, presented on this page, are shown the curves of pressure drop for 1-in. and 1¼-in. pipes and oil of 100 Saybolt seconds plotted on log-log paper. If, now, one adds the rates of flow at the various pressure drops, the result is the combination curve shown. From this curve the pressure drop per 1000 ft. for this fluid at any rate of flow can be found, or if the allowable pressure drop be known, the quantity of flow can be found. A series of curves can readily be made up for any combination of lines if the basic curves are available. Flow curves for various combination lines that will cover the sizes normally used in piping and pipe line work will be given in later articles after the present series of charts has been presented.

The following example shows how this type of curve can be applied to the solution of problems:

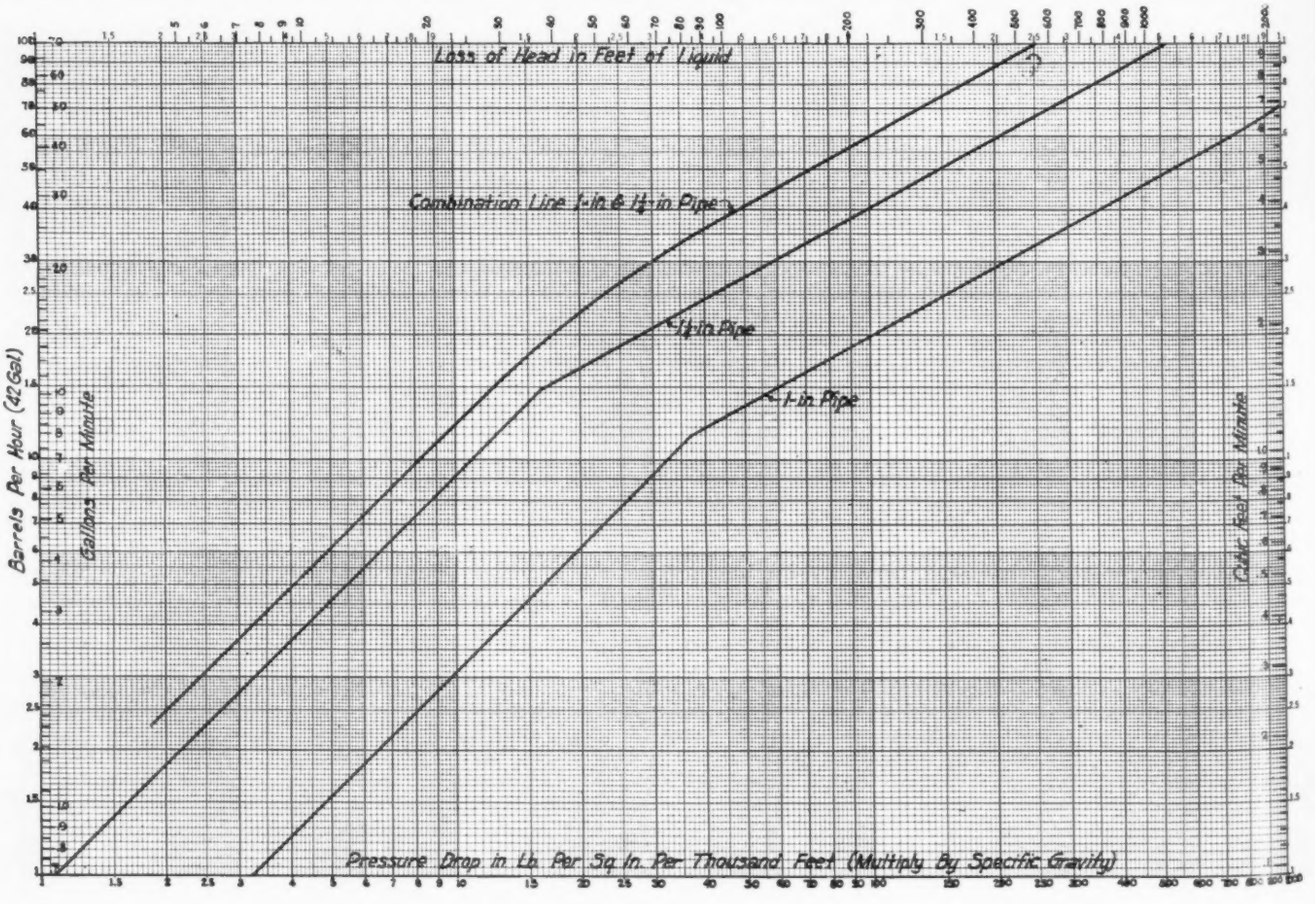
Assume that it is desired to pump 25 bbl. of oil per hour having a viscosity of 100 Saybolt seconds and a specific gravity of .9 through a 1¼-in. line and a combination 1-in. and 1¼-in. line with a total pressure drop of 250 lb. per sq. in. in 10,000 feet. It is, therefore, necessary to find the length of combination line to make this possible. From the chart for 1¼-in. pipe, it is seen that the pressure drop per 1000 ft. will be (42×.9) lb. per sq. in., and from the chart, the combination line will show a drop of (22.8×.9) per 1000 feet. If we let x be the length of combination line in 1000 ft. the length of 1¼-in. line will be 10—x.

We have, then:

$$x\ (22.8\times.9) + (10-x)\ (42\times.9 = 250$$

$$\text{or} \quad x = 7.41$$

One would, therefore, use 2590 ft. of 1¼-in. and 7410


Loss of Head in Feet of Liquid
Combination Line 1-in & 1¼-in Pipe
1¼in Pipe
1-in Pipe
Barrels Per Hour (42 Gal)
Gallons Per Minute
Cubic Feet Per Minute
Pressure Drop in Lb. Per Sq In. Per Thousand Feet (Multiply By Specific Gravity)

It's surprising how clearly any defects are seen

INTERIOR inspection is one of the important checks on the quality of **J&L** Seamless Pipe. With a light at each end, the slightest irregularity is easily detected. One out of every six men in the **J&L** Seamless Tube Department is engaged in testing and verifying. The selection of raw materials, the quality of the steel, the strength and dimensions of pipe and couplings, accuracy of threads, etc., are checked and rechecked to assure strength, precise dimensions and uniformity. An interesting illustrated treatise on pipe manufacture is included in the **J&L** Pipe Handbook, copy of which will be sent on request. There is no obligation.

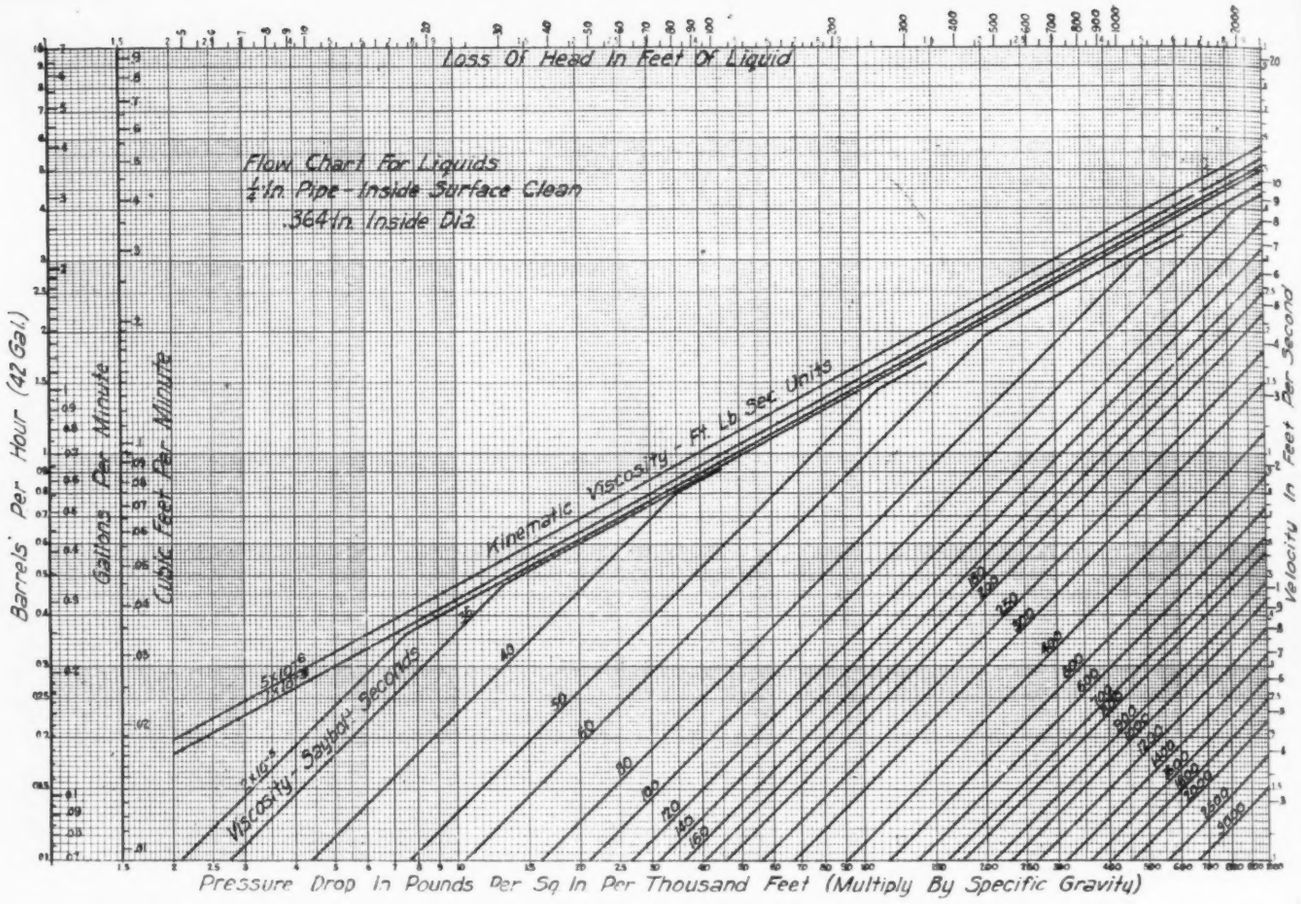
JONES & LAUGHLIN STEEL CORPORATION
AMERICAN IRON AND STEEL WORKS
JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

J&L STEEL

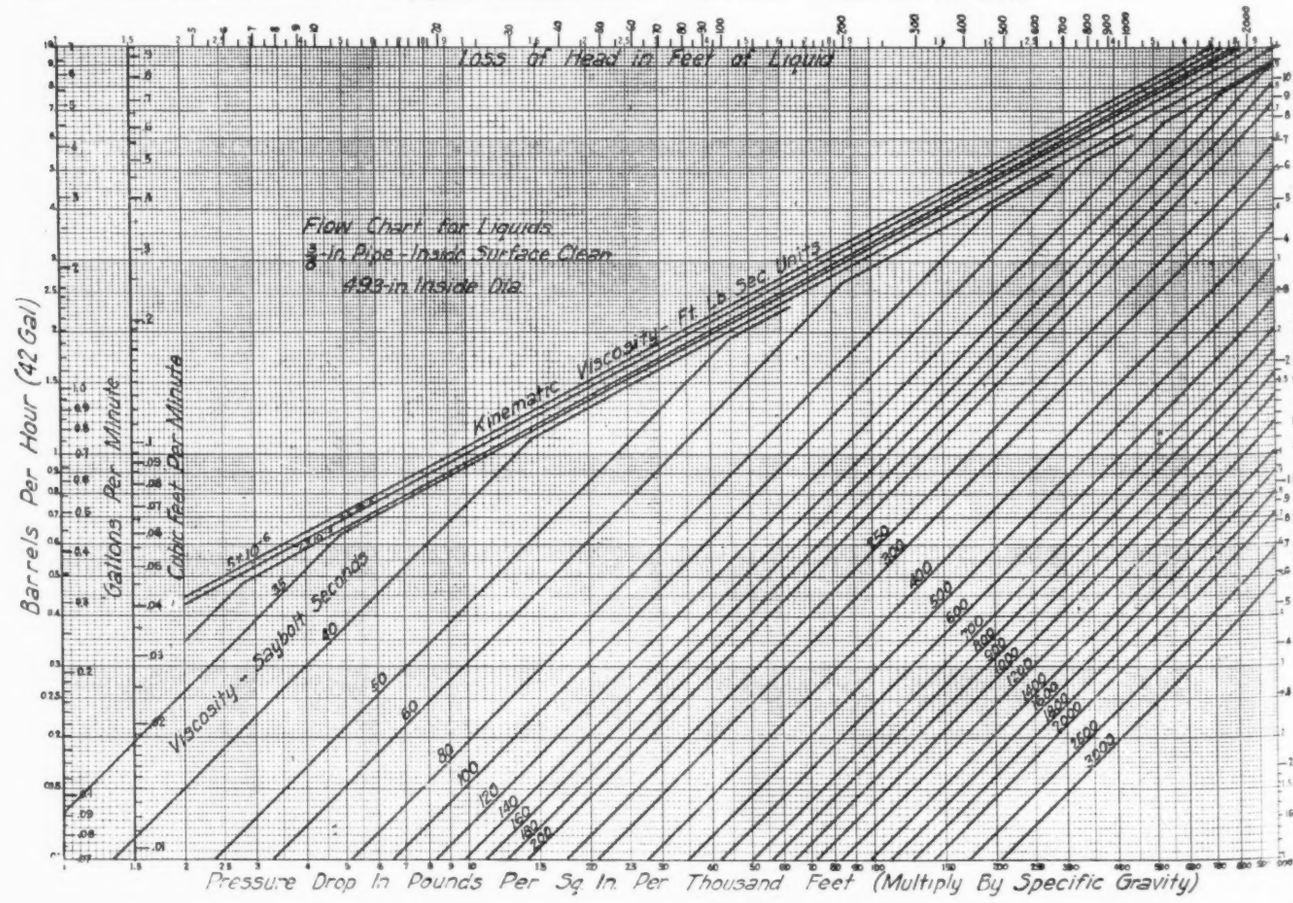
J&L PIPE

J&L SEAMLESS

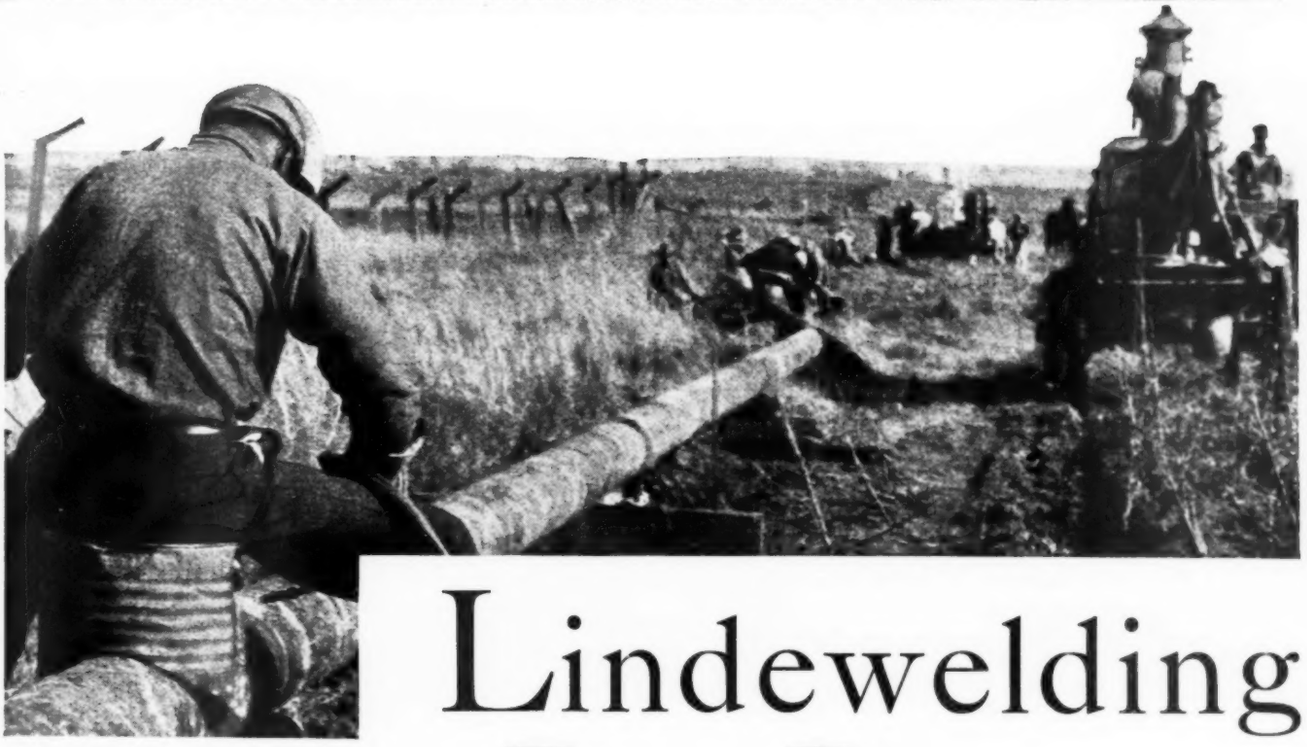
DRILL PIPE · CASING · TUBING · LINE PIPE


Loss Of Head In Feet Of Liquid
Flow Chart For Liquids
¼ In. Pipe - Inside Surface Clean
.364 In. Inside Dia.
Barrels Per Hour (42 Gal.)
Gallons Per Minute
Cubic Feet Per Minute
Kinematic Viscosity - Ft. Lb. Sec. Units
Viscosity - Saybolt Seconds
Velocity In Feet Per Second
Pressure Drop In Pounds Per Sq In Per Thousand Feet (Multiply By Specific Gravity)

ft. of combination line made up of 1-in. and 1¼-in. pipe. Since the pressure drop across each of the lines when used in combination will be 22.8×.9, it can be seen from the chart by tracing up from $\frac{22.8 \times .9}{.9} = 22.8$, that the flow in the 1-in. line will be viscous and at the rate of 7.00 bbl. per hour, and that the flow in the 1¼-in. pipe is turbulent and at the rate of 18 bbl. per hour. The velocities in the separate lines can then be found from the curves for the separate lines. Further information on the application of the curves to the solution of parallel line problems will be given later when the pressure drop curves are presented. On this page two more flow charts are presented this month; one for ⅜-in. pipe, and the other for ¼-in. pipe.


Loss of Head in Feet of Liquid
Flow Chart for Liquids
⅜-in Pipe - Inside Surface Clean
.493-in Inside Dia.
Barrels Per Hour (42 Gal)
Gallons Per Minute
Cubic Feet Per Minute
Kinematic Viscosity - Ft. Lb. Sec. Units
Viscosity - Saybolt Seconds
Velocity in Feet Per Second
Pressure Drop In Pounds Per Sq In. Per Thousand Feet (Multiply By Specific Gravity)

YOU CAN ORDER EVERYTHING FOR PIPE LINE LINDEWELDING FROM LINDE



Lindewelding *speeds up Pipe Re-laying*

A LINDE customer had a hurry call for a 42-mile gathering line. Plenty of usable pipe was available in abandoned lines. From past experience this concern knew Linde Process Service could give valuable assistance . . . and help save money. Linde was called on to help reclaim enough 8-in. pipe, in lengths averaging 18 ft., to do the job in record time.

Linde Service Operators went to work . . . right on the firing line. They demonstrated the best way to use the Wagner Cutting Machine for reclaiming used pipe. They instructed the operators of welding equipment in the latest Lindewelding technique . . . and stayed on until the job was well under way.

Results came fast. With Lindewelding, more than three times as many welds were made in the time required by other methods. Welders averaged 45 welds per 8-hr. day. One welder made eight welds in one section in *just 58 minutes . . . nearly one weld every seven minutes!* And . . . over 25 per cent less oxygen, acetylene and rod were used per joint than on previous work!

Performance records are a good reason why this customer, like many others, continues to buy *everything for pipe line welding and cutting from Linde.* All Linde customers are entitled to the full cooperation of Linde Process Service.

Linde Process Service can help you, also, to organize pipe line welding and cutting operations for greater speed, dependability and profit. Linde's experience with the special job of reclaiming and relaying old pipe lines has been extensive and thorough. If you have a job of this special nature, you should avail yourself of Linde's store of profitable data and time-saving developments.

Ask the nearest Linde Sales Office to show you without obligation how Linde can be of help to you on all your pipe line construction operations.

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

NRA CODE

Sales Offices: Atlanta Baltimore Birmingham Boston Buffalo Butte Chicago Cleveland Dallas Denver Detroit El Paso Houston Indianapolis Kansas City Los Angeles Memphis Milwaukee Minneapolis New Orleans New York Philadelphia Phoenix Pittsburgh Portland, Ore. St. Louis Salt Lake City San Francisco Seattle Spokane Tulsa

IN CANADA, DOMINION OXYGEN CO., LTD., TORONTO

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

WHY East Texas Producers Pump East Texas Wells with ELECTRICITY

● East Texas Oil Companies and Operators are buying electric power for well pumping, principally because the rates offered are among the lowest in the entire country. Electric power is the right power for the automatic operation of wells on intermittent schedule in prorated fields.

● The first cost of electric motor installation is about one-sixth the cost of an internal combustion engine installation. Electric equipment has a high salvage value. With purchased electric power, rod-costs, rig-costs and labor-costs are reduced to a minimum.

● Electric power is the modern, dependable power. It encourages efficient operation and results in a low overall lifting cost per barrel of fluid.

● Complete information on the cost of pumping wells with electric power can be obtained through our offices at Gladewater, Longview, Henderson or Kilgore, or may be had direct from our General Office at Shreveport, Louisiana.

ADVANTAGES in Electricity for PUMPING in East Texas

- Lower first cost.
- Lower maintenance cost.
- Lower fixed charges (taxes, interest, insurance, depreciation, etc.)
- Less trouble, fewer repairs, smoother operation.
- Longer life for all equipment.
- Smaller warehouse stock of repair parts.
- Fewer accidents.
- Less fire hazard.
- Not affected by bad water or shortage of water.
- Not affected by sour gas or gas shortage.
- Not affected by freezing in gas or water lines.
- Easy to start in any weather.
- Operation can be controlled automatically.
- Counterbalancing more easily accomplished.
- High salvage value in electric equipment—easily moved.
- Pumping with electricity makes the cost of electricity for other purposes around the lease much lower.
- Clean and efficient
- Accurate records more easily kept.
- Less shut-down time.
- LOWER OVERALL COST PER BARREL OF FLUID LIFTED.

SOUTHWESTERN GAS & ELECTRIC CO.

Now Lane-Wells Representative at Houston

Elmer R. Smith, of the Lane-Wells Company, who, as announced in the last issue of *The Petroleum Engineer*, has been transferred from Los Angeles, California, to Houston, Texas, where he is in charge of the service and sales of the company in the Gulf Coast, Texas, and Mid-Continent territory.

H. C. Potts Newly Appointed Vice-President Kerotest Manufacturing Co.

Harry C. Potts, for over 15 years in the sales and service department of the Kerotest Manufacturing Company, Pittsburgh, Pa., has just been made vice president of the company.

His is a familiar name in every important oil producing center throughout the world, and his many friends will welcome this recognition of the results he has accomplished in furthering the sale of Kerotest cast steel valves and fittings.

Tractor Sets Speed Record of 65.45 Miles Per Hour

Attaining a speed of 65.45 miles per hour on an Allis-Chalmers Model "U" over a measured mile at Brecksville, O., Ab Jenkins, holder of many world and A.A.A. automobile speed records, established a new high speed record for farm tractors. Ab said that he had never been on a farm tractor until the afternoon of the day before he made the new high mark.

"Why does anyone want to drive a farm tractor 65 miles an hour?" asked a bystander.

The answer came from W. Ellzey Brown, sales promotion manager of Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. It is to show tractors can be built to do more than the routine jobs of power farming. The tractor of the future will be used to transport goods from farm to market. Power farming equipment design will keep step with progress in tractor design. Tools will be made that will take advantage of the higher speeds at which air tired tractors can be economically operated.

"Air tires have made these high speeds possible. When the farmer can take his produce into town behind his tractor at 25 to 30 miles per hour, he will no longer be content to operate his plow or harrow or harvester or what-have-you at from 1½ to 3¼ miles per hour. We are living in an age of speed."

This same high-speed tractor also has been especially designed and equipped with a general oil-field winch that has incorporated in its construction the latest refinements in internal combustion engine design.

W. V. C. Jackson with Struthers-Wells Co.

Struthers-Wells Company, Warren, Pa., announces the appointment of W. V. C. Jackson as district sales representative in Oklahoma, Kansas and the eastern part of Texas, with offices in the National Bank of Tulsa Building, Tulsa, Oklahoma. Jackson formerly was with the A. O. Smith Corporation and served them in a similar capacity in this same territory.

A. G. Haglund of Axelson Manufacturing Co. on Extended South American Trip

Embarking upon an itinerary that will take him to every oil-producing country in South America, A. G. Haglund, vice-president and works manager of the Axelson Manufacturing Company, Los Angeles, left Miami, Florida, recently, via plane, for Maracaibo, Venezuela. His trip will cover a three to four months period, notwithstanding the fact that wherever possible he will utilize the airplane for transportation. According to J. C. Axelson, president of the Axelson organization, Haglund's trip has been planned with the idea of offering suggestions and solutions to production problems confronting operators in the countries he visits.

Mr. Axelson says: "Numerous requests from officials of oil companies in South America for information as to the latest products and improvements have necessitated sending a representative direct to the oil fields to make personal contacts."

A. G. HAGLUND

At Maracaibo Haglund will spend approximately one month in company with C. C. McDermond, Venezuelan representative for the Axelson concern. From Maracaibo he will go to Colombia and from there to Trinidad, British West Indies, where he will work in co-operation with officials of C. Tennant Sons & Company, Axelson representatives in that territory. From Trinidad Haglund goes to Buenos Aires via Rio de Janeiro. The Axelson representative in the Argentine territory, John R. Webb, will work with him in that country. From Buenos Aires he will cross to the Pacific Coast via Santiago, north to Talara, Peru and thence to Guayaquil, Ecuador. At all of these points operating oil companies are using equipment of Axelson design.

This will complete Haglund's extended South American visit and he will then fly from Guayaquil direct to Panama or Cristobal, proceeding by steamer to the United States.

DON COLLINS, of the Shell Oil Company of California, where he was superintendent in the Ventura field, has been transferred to Houston, Texas, as general superintendent, succeeding G. R. Henson, resigned.

J. D. WHEELER, petroleum engineer, Mid-Kansas Oil and Gas Company, has been transferred from East Texas to the Yates field, West Texas, to take the place of Bob Kyner, recently resigned.

C. E. MEDLEY, formerly sales engineer with the Oil Well Supply Company, East Texas, is now with the American Manufacturing Company of Fort Worth.

WM. HORNER, petroleum engineer of Forest Oil Corporation, Bradford, Pa., was in attendance at the A.I.M.E. meeting, Tulsa, Oklahoma, October 12 and 13.

D. A. LITTLE, president of the Magnolia Petroleum Company, has been chosen to head the Dallas Petroleum Club. His selection was made at a recent meeting of the board of governors of the club. Russell S. McFarland, of the Texas Seaboard Oil Company, was elected vice-president, and Harry Morlang, of the Oil Well Supply Company, secretary-treasurer.

C. E. BURLINGAME, oil and gas producer of Bartlesville, Okla., is now on a tour of the world.

J. M. SAPPINGTON, JR., of Holdenville, Okla., is now with the Southport Refining Company at Longview, Texas. He formerly was employed by the Gilmore Gasoline Company.

GEORGE LEWIS FERGUSON, formerly superintendent of the Argo Oil Company at Salt Creek, Wyoming, is now at Santa Ana, California.

C. A. BOLER, president of the Boler Petroleum Company, Philadelphia, Pennsylvania, is on a foreign tour that will take him to all the leading European countries.

S. J. M. AULD, London, England, recently was made chief technologist of the Vacuum Oil Company, Ltd.

CECIL E. KEEP, formerly petroleum engineer with the Attock Oil Company, has joined the British Burma Petroleum Company at Yenangyaung.

ELMER F. SCHMIDT, general superintendent of the Lone Star Gas Company, Dallas, Texas, attended the annual meeting of the American Gas Association, held in Atlantic City October 29.

MIKE MURPHY, Dallas, Texas, Mid-Continent representative of the Air Reduction Sales Company, New York City, recently spent several days in the home office, and while in the East attended the meeting of the American Gas Association at Atlantic City.

M. G. ENSINGER, vice-president and general manager of the Union Wire Rope Corporation, and Hal R. Gruber, vice-president and sales manager, have returned from a two-weeks' visit to Mexico, where they called on customers of their company in the oil producing districts with Senor Enrique O. Chapa, the company's sales representative in Mexico. Ensinger was the principal speaker at a meeting of Mexican oil men at the Imperial Hotel, Tampico. He spoke on "Wire Rope—Its Uses and Abuses."

J. D. MCNUTT, Tulsa, Oklahoma, manager of the Southwestern producing division of the Pure Oil Company, has succeeded Alvin Richards, general attorney of the same company, on the Oklahoma production committee of the planning and coördination committee, according to an announcement from Washington. D. T. Gardner, of Wichita Falls, Texas, and D. B. Collins, of Houston, have been added to the Texas drilling practices committee, taking the places of George B. Cree and G. R. Henson, retired. C. R. McKay, of the Sinclair Refining Company, Sand Springs, Oklahoma, has been appointed to the District No. 4 refining committee.

A. SLAYTER, of Laramie, Wyoming, has been appointed Wyoming representative for Manning & Terry, Inc., Tulsa, drilling contractors.

DR. R. K. STRATFORD, chief chemist for Imperial Oil Refineries, Ltd., Sarnia, Ontario, Canada, recently returned from a six weeks' trip to France. He was called to France to act in an advisory capacity in connection with the construction of a new refinery.

CLIFFORD S. WILSON, a production engineer with the Venezuela Gulf Oil Company, who is home on leave, was a recent visitor in the Texas and Mid-Continent fields.

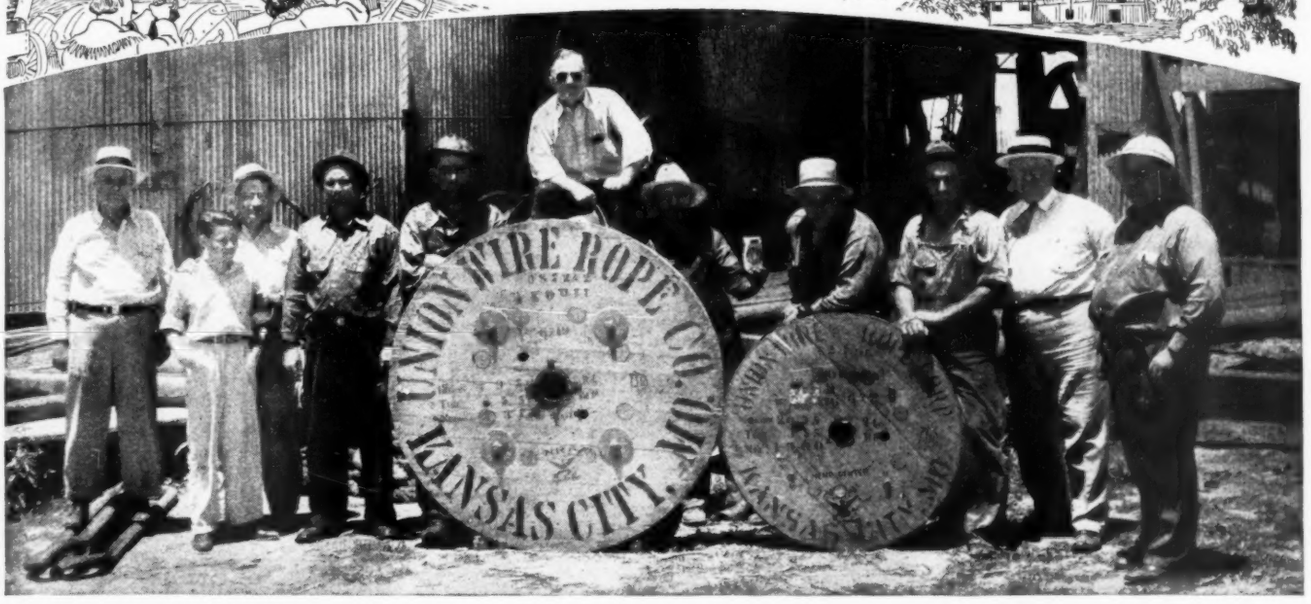
DRS. GERALD L. HASSLER and E. S. HILL have joined the petroleum engineering staff of the Pennsylvania State College School of Mineral Industries, replacing Dr. George H. Fancher and J. O. Lewis, who resigned last summer. Dr. Hassler had been with the Gulf Research Laboratory in Pittspurgh, and Dr. Hill with the A.P.I. at Pasadena, California, prior to joining the college faculty. Both recently received degrees from the California Institute of Technology after having completed work for their doctorates.

D. V. CARTER, petroleum engineer for the Magnolia Petroleum Company, now makes his headquarters at the general offices of the company in Dallas, Texas, having been transferred from Longview, where he has been the last three years.

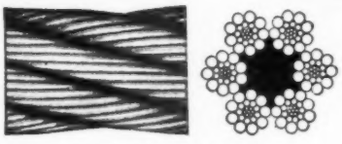
JAMES C. HEWLETT, formerly material accountant for the Mid-Continent Petroleum Corporation at Tulsa, Oklahoma, is now located at Carapito, Venezuela, with the Standard Oil Company of Venezuela.

R. A. CATTELL, chief of the Petroleum and Helium Divisions of the U. S. Bureau of Mines, Washington, D.C., visited the Bartlesville Experiment Station of the Bureau during October. He also attended the A.I.M.E. meeting at Tulsa.

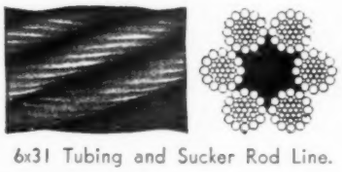
HARD TO LICK



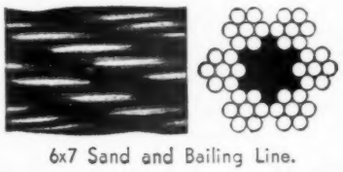
TEXANS - AND UNION LINES



6x19 Flexible Seale Rotary Drilling Line.



6x31 Tubing and Sucker Rod Line.



6x7 Sand and Bailing Line.

It was a hardy race of fighting men who wrested Texas from the Indians and developed her into a great state. History records that the Alamo was not surrendered until the last man had fallen, and that Texas was the last state to submit, at the close of the Civil War. Texans are hard to lick!

Maybe that's why they like Union Wire Lines. UNION lines are also hard to lick. Designed especially for oil field use, their high grade steel and expert tempering and fabrication enable them to take an amazing amount of punishment and stand up for more. Their popularity is steadily growing in Texas oil fields.

The above picture was taken at Christie Hickman Drilling Company's "T. J. DeSpain No. 2," Wheeler County. Left to right, those shown are: H. L. Graham, independent producer; Chas. Christie, Jr., son of C. B. Christie; C. B. Christie, of Christie-Hickman; C. W. Metz, driller; D. F. Thompson, tooldresser; J. C. Day, railroad commissioner; Jimmie Boyle, visitor and old-timer; Chas. Hickman, of Christie-Hickman; Fred Sragué, visitor; Hal Gruber, Union Wire Rope Corporation; C. B. Martin, Jarecki Mfg. Co.

UNION WIRE ROPE CORPORATION

Executive and Sales Office: 601 Beacon Life Bldg., Tulsa, Okla.

Branch Office and Warehouse: Portland, Ore. Warehouse: Monahans, Texas Factory and Acct. Dept.: 21st & Manchester, Kansas City, Mo.

JARECKI MFG. CO., Midcontinent & Eastern Oil Fields Dist'ors—Stocks at all stores

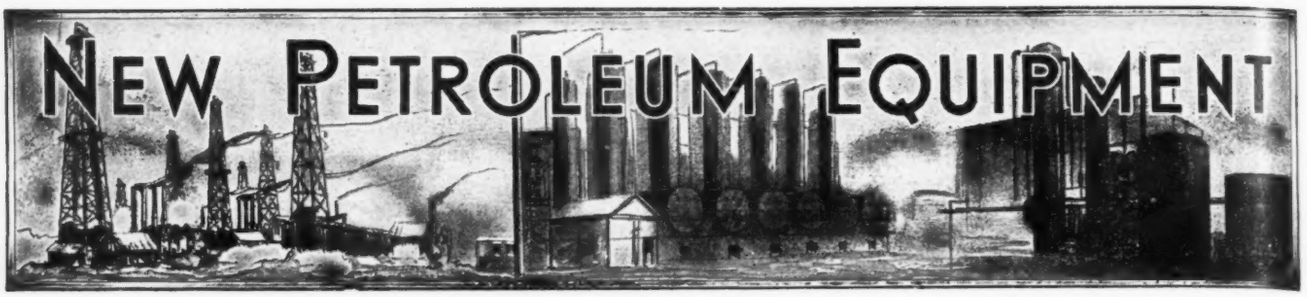
MARION MACHINE FOUNDRY & SUPPLY COMPANY, Rocky Mountain Fields

ENRIQUE O. CHAPA, Representative for the Republic of Mexico

Calle Damas Sur 13, Tampico Modero 2, Mexico, D. F. Stocks at Tampico, Mex.

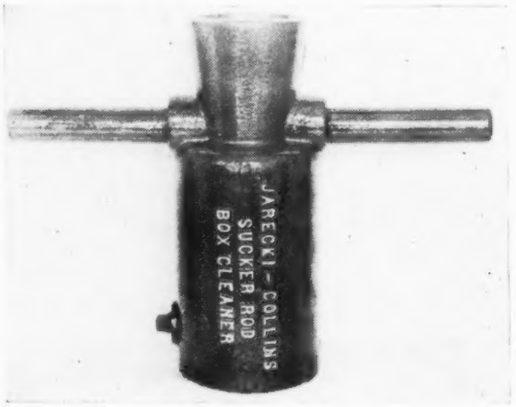
UNION WIRE LINES

The "ULTIMATE LOW COST WIRE ROPE"



Jarecki-Collins Sucker Rod Box Cleaner

THE JARECKI-COLLINS sucker rod box cleaner is a device for removing dirt, sand and gritty material from sucker rod boxes and couplings. No matter what precautions are taken, foreign matter will be picked up and will adhere to the threads in the boxes or couplings and on the pins. This is especially true in windy or sandy country. Joints made up with such foreign material on the threads will not shoulder, and when run into the well in this condition, pin failures usually result. The Jarecki-Collins sucker rod box cleaner provides a simple, quick, and effective means of cleaning and lubricating the box and coupling threads.



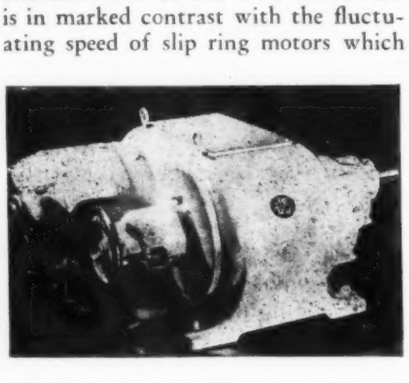
The cleaner is used when the rods are being run into the well. With the rod, or stand of rods, suspended in the derrick, the box or coupling is guided into the funnel of the cleaner, and the cleaner raised and lowered under the rod three or four times. This movement causes the plunger in the cleaner to be forced downward, and the cleaning fluid to be jetted against the threads with great force. Repeating the operation several times insures thorough washing of the threads, and removal of all dirt, at the same time leaving a film of lubricating oil on the threads.

The cleaning fluid should consist of lubricating oil thinned with kerosene. The fluid recommended consists of two parts engine oil and one part kerosene. When only a lubricating effect is wanted, as in running new rods or rods whose joints are clean and free from sand or dirt, the fluid may consist entirely of engine oil, or any light lubricant. Crude oil free from sand or water may also be used. The cleaning fluid is poured into the cleaner through the funnel on top of the body until the fluid level reaches the lower edge of the funnel, and is used repeatedly until dirty, the dirt settling into a space at the bottom of the cleaner. After the cleaner has been in operation for some time, the drain plug should be removed and the fluid and dirt drained out.

For further information, write Jarecki Manufacturing Co. at St. Louis, Mo., or Tulsa, Okla.

U. S. Varidrive Motor

A NEW geared motor with a thousand speeds has been developed for the petroleum industry. It offers any and all speeds over a wide range without intricate control mechanisms. Merely by turning a wheel the speed of the motor can be increased or decreased. It is called the U. S. Varidrive motor. This product is a self-contained unit instead of having extraneous gear-changing devices and it embodies an electro-mechanical power conversion which changes the fixed constant speed of the motor to variable speeds at the take-off shaft. Variations of 1, 10 or 100 revolutions or more are available. The stability and non-fading speed characteristics of the Varidrive Motor is in marked contrast with the fluctuating speed of slip ring motors which are sensitive to load changes.



The Varidrive consists of a simple squirrel cage motor built integral with a variable speed transmission. The latter comprises dual discs coupled with a varibelt. Speed changes are obtained by varying the effective diameter of the discs. The operator merely turns a hand wheel which actuates a traveling hub. This, in turn, increases or diminishes the distance between the two sides of the driven discs. The motor element is comprised of a standard U. S. rotor with Auto-Start principle. The motor is asbestos-protected.

This new type of variable speed motor is finding numerous applications in many industries. It permits of increased efficiency by enabling the operator to set the driven machine at the exact speed desired for any specific operation instead of being obliged to resort to belts operating on cone pulleys, intricate gearing or supplementary speed devices. The entire unit occupies little more room than an ordinary motor and can be direct-connected to driven machines.

It is manufactured by the U. S Electrical Manufacturing Company. A bulletin describing and illustrating its operation may be procured from the manufacturer, 1510 South Western Avenue, Chicago, or 202 East Slauson Avenue, Los Angeles.

Sotco Wash-over Hydraulic Wall Hook

SPECIALTY OIL TOOL COMPANY, Los Angeles, Calif., announces their new Wash-over tool to complete their line of fishing tools. It is unusual because of its eccentric construction giving it the added advantage of a powerful rotary movement and it is designed for use below the overshot, socket, cutter or whatever engaging tool is used for recovery of the fish. Its function is to bring the top of the fish into contact with the overshot, socket or cutter in such a position as to enable the recovery to be made.

The tool is constructed with a heavy wall hook arm which is operated by hydraulic pressure. This arm can be rotated with a circular sweep of 15 ft. (6-in. size) for location of the

(Continued on Page 149)

HOW MANY TOOLS DOES IT TAKE TO MAKE A JOINT ?

JUST 1

When You Use

DRESSER

Couplings

A DRESSER Ratchet Wrench is simple, easy and speedy to operate. No other tool is needed to pull up the bolts on a Dresser Coupling. This one tool completely eliminates the need for noisy, expensive, complicated jointing equipment that involves heat or power.

With Dresser Ratchet Wrenches and Dresser Couplings, unskilled labor can make permanently, *absolutely* tight joints in minimum time. Manual operation of a Dresser Wrench requires such little effort and is so exceptionally fast that the resulting tightness of the joints never fails to impress the engineer who has experienced difficulties with other types of construction.

S. R. DRESSER MANUFACTURING COMPANY
Bradford, Pa.
In Canada: Dresser Mfg. Company, Ltd.
32 Front Street, W., Toronto, Ontario

Dresser Products: STEEL COUPLINGS • CAST COUPLINGS • STEEL SLEEVES BELL JOINT CLAMPS • COLLAR LEAK CLAMPS • POROUS WELD CLAMPS • SPLIT REPAIR SLEEVES • EXPANSION JOINTS • REDUCING COUPLINGS • INSULATING COUPLINGS • RATCHET WRENCHES • *and many other modern accessories for pipe.*

(Continued from Page 146)

fish. When contact has been made, continued rotation for wash-over purposes results in dislodgment of the fish.

It is then possible to pass the lengths of wash-over pipe down over the fish until it is caught by the fishing tool in the string above. The tool itself is composed of two movable members, head and body. The body of the tool engages the head at the top intersection in a perfect ball joint, thus enabling the stress of all weight to be taken directly by the two respective ball and socket joints on opposite sides of the square at the top of the body. The pulling stress is taken care of by four threaded weight pins and two threaded hinge pins, the hinge pins being threaded directiy through the body and head of the tool on either side. The four weight pins are screwed into the body and inserted into radius slots milled into the head. The opening operation of the tool is controlled by a flapper valve. When it goes in the hole the valve sets up in approximately a two-thirds closed position. When the pump pressure is applied the flapper valve moves down to a closed position, opening the tool by the action of the trigger located on the attached end of the valve. When the fish is engaged the tool automatically straightens up, coming back to a closed position and the flapper valve drops back into the eccentric slot, allowing full opening clearance through the tool. At the top end of the flapper valve the trigger is so set that in washing-over a fish when pulling the wash pipe back out of the hole it allows tool joints to pass the valve.

Bronze Gate Valves

THE KENNEDY VALVE MANUFACTURING COMPANY has announced a new line of rising stem heavy standard bronze gate valves for 150 lb. working steam pressure and 250 lb. working water, oil or gas pressure.

This valve, known as Fig. 45, is a companion type to the new Fig. 23 with stationary stem introduced earlier in the year. The operating mechanism employs solid wedge discs that are simple, heavily proportioned and accurately machined, and having no small quick-wearing parts that might cause trouble in service. This mechanism has been used for many years in other Kennedy Valve types and has operated with ease and certainty in any position, the manufacturers state.

A flexible connection is provided between the disc and the stem so that the stem will not bind or spring when the valve is closed. The stem is made of a bronze composition with high tensile and torsional strength, and has a large number of contact threads in the bonnet.

The bonnet hexagon is made extra-large and close to the body so that when a wrench is applied for installing or disconnecting, there will be no danger of distorting the bonnet. Additional features of this new Kennedy design are the deep stuffing box with gland and square section molded packing rings, the large non-heading mal-

(Continued on Page 150)

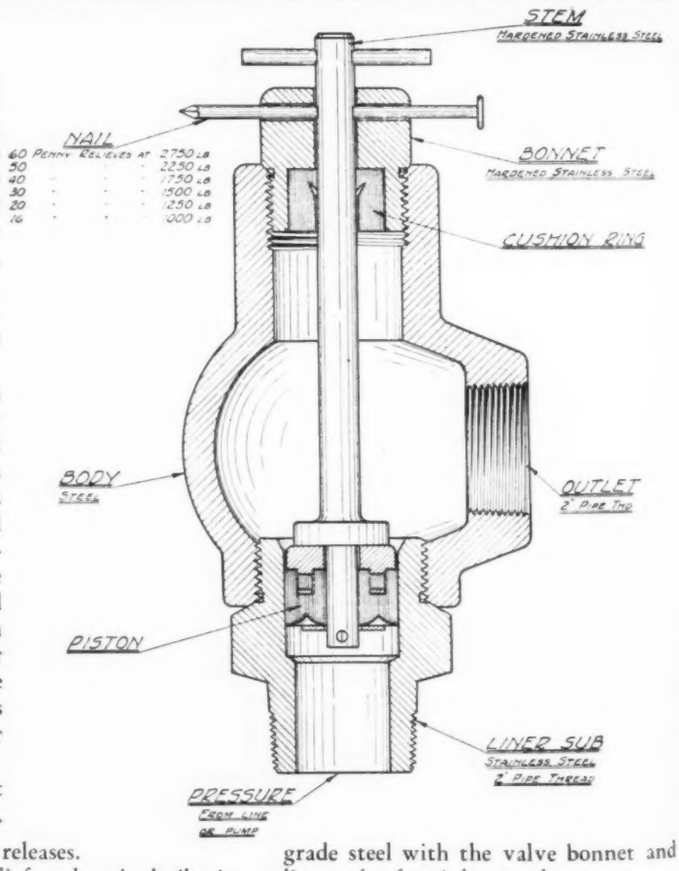
Abercrombie Shear-Relief Valve

THE ABERCROMBIE PUMP COMPANY, Houston, Texas, is now on full production of the Abercrombie patented shear-relief valve that was developed some time ago as an entirely new design for protecting pumps and pump parts against over-pressure. Since its introduction, this valve has been tested under most strenuous conditions and, according to the manufacturers, is operating satisfactorily throughout the country.

Pump pressure against a specially designed rubber piston is relieved at a set point by the shearing of a common wire nail set in a hardened stainless steel valve stem. Each valve carries a table on the name plate listing nail sizes and the pressure at which each nail size shears. To further simplify setting of the valve a nail gauge also is included so the operator cannot mistake nail sizes.

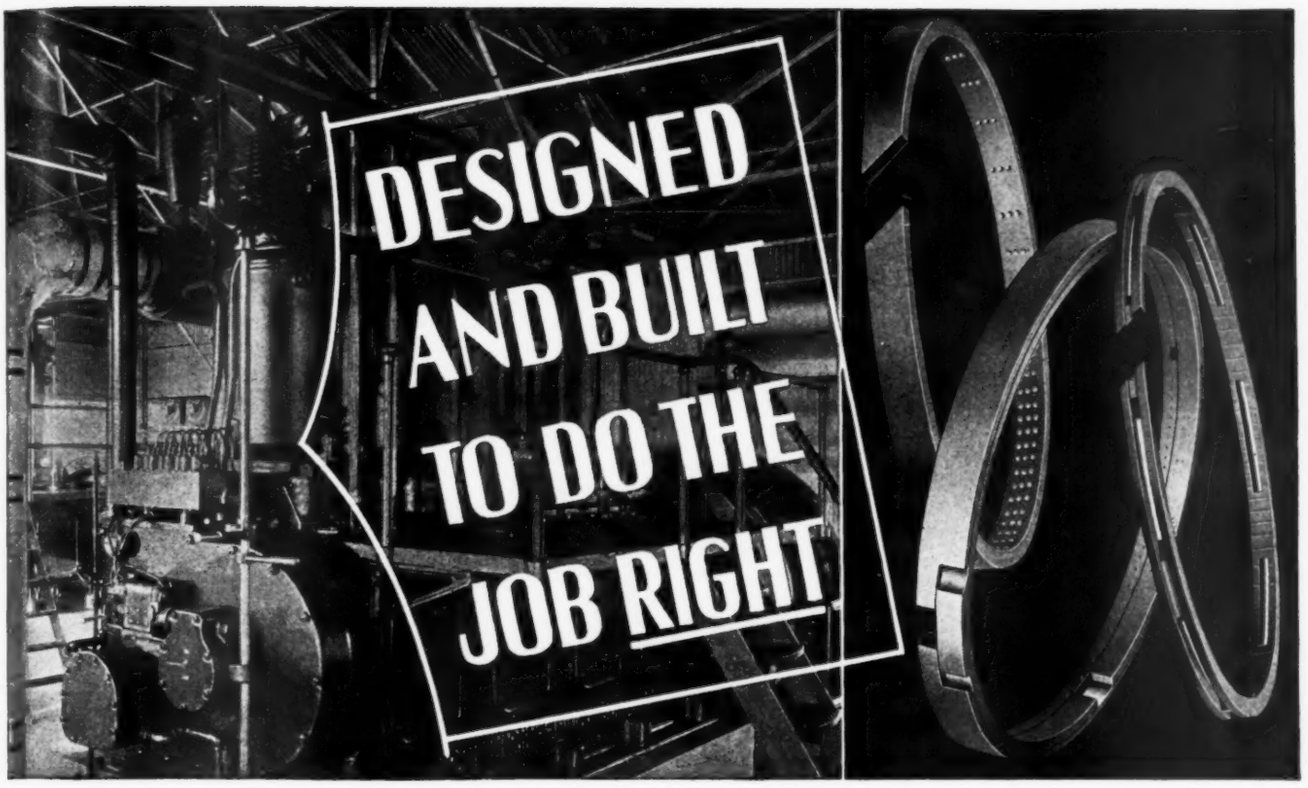
The design is such that it cannot leak when closed. A special rubber lip presses the piston harder against the stainless steel wall as pressure increases, and this combination of materials prevents corrosion or sticking of the piston. Relief is instantaneous when the nail shears, the piston traveling across the valve body, entirely out of the way of the fluid flow.

Loss of the nail is the only damage when the valve releases.



The shear-relief valve is built in 1000 to 2750 lb. pressure for slush pump service and 250 to 1000 lb. pressure for gathering pumps or similar service. While the same principle is involved in both high- and low-pressure types, the low-pressure valve body is a single-unit bronze casting and the high-pressure body is made of high-grade steel with the valve bonnet and liner sub of stainless steel.

Since the low-pressure valve piston commonly contacts oil, this piston is made of a special composition undamaged by hot oil, chemicals or any other corrosive agents. The outlet on the low-pressure valve may be equipped with a lead line to return the oil to the pipe-up line, to prevent waste.



AMERICAN Hammered Piston Rings have won the high esteem of the oil industry because of their dependable and economical performance that cuts power losses and saves costly operating and maintenance charges. And this has been made possible because there is an American Hammered Ring specifically designed and built for every job—and to do that job *right*.

Then, too, American Hammered Rings are *hammered*—an exclusive process that gives them uniform tension that can never wear out during their entire life.

These are only a few of the important reasons why you will find American Hammered Piston Rings so widely accepted in the drilling, pumping and refining operations throughout the entire oil industry.

Let us give you the complete story of the painstaking manufacture and correct application of American Hammered Rings. An instructive, well-illustrated Hand Book describing the manufacture, purpose and application of every type of ring is yours for the asking. Simply mail the coupon.

THE AMERICAN HAMMERED PISTON RING COMPANY
BALTIMORE, MARYLAND

IN EVERY SIZE
OF EVERY TYPE
FOR EVERY PURPOSE

American Hammered
PISTON RINGS

BRANCH OFFICES:

Chicago, Ill.	1346 Washington Blvd.
Fort Worth, Texas	2603 Azle Ave.
Houston, Texas	4605 Polk St.
Long Beach, Calif.	501 Pico St.
San Francisco, Calif.	320 Market St.
Pittsburgh, Pa.	5668 Darlington Rd.
Seminole, Okla.	107 First St.
Tulsa, Okla.	404 East Second St.
Winfield, Kansas	

Mail today! THE AMERICAN HAMMERED PISTON RING COMPANY
Baltimore, Md.

Gentlemen: Please send me a free copy of your Hand Book, and place my name on your mailing list.

*Name*_____

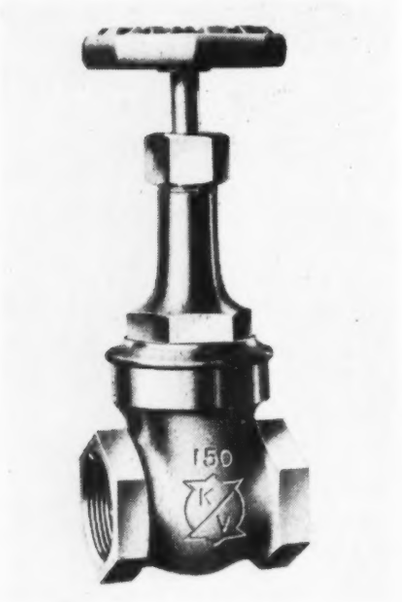
*Position*_____

*Company*_____

*Address*_____

(Continued from Page 149)

leable-iron hand wheel which is secured to the stem by a nut, and the



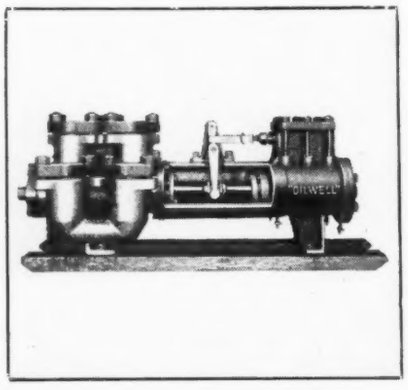
heavy, wide pipe-end hexagons with a generous number of threads.

Additional information concerning these valves can be obtained by addressing The Kennedy Valve Mfg. Co., Elmira, New York.

"Oilwell" 6x4x6-A Duplex Steam Pump

THE OIL WELL SUPPLY COMPANY of Dallas, Texas, recently introduced a new pump for boiler-feed and general service, which is designed as the "Oilwell" 6x4x6-A Duplex steam pump. It weights 818 lb., the steam cylinder bore is 6 in., the maximum fluid piston diameter is 4 in., and the length of stroke is 6 inches.

The outstanding feature of the "Oilwell" 6x4x6-A Duplex steam pump is the close-clearance type "direct-flow"



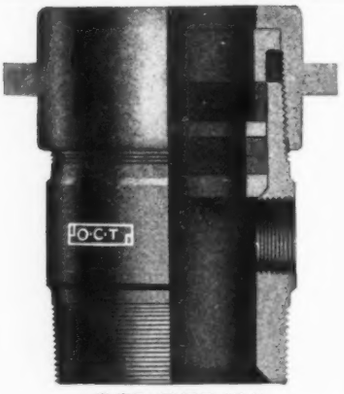
fluid end, which is similar in design and appearance to the fluid ends which have proven very satisfactory on the manufacturer's Imperial No. 14 (14 in. x 7¼ in. x 14 in.) and Imperial No. 20 (15 in. x 7¾ in. x 20 in.) slush pumps. The design of the fluid end provides large fluid passages and eliminates unnecessary twists and turns and all air pockets. This construction reduces flow-resistance to a minimum and increases pump efficiency to a maximum.

The fluid chamber is a one-piece, close-grained, semi-steel casting. It is hydrostatically tested at 1000-lb. per sq. in. pressure and is recommended for a maximum fluid working pressure of 500 lb. per sq. inch.

Bronze fluid valves of the wing-guide type with bronze seats and wide bearing surfaces are regularly furnished. The valve seats have a tapered fit. The liberal valve area reduces flow restriction. Several other types of valves and seats can be furnished to equip the pump for various kinds of service. Each fluid valve is located in an individual valve pot with a bolted cap such as used on a slush pump. This permits inspection or replacement of a single valve without the necessity of removing an entire valve deck.

Cast-iron follower-type fluid pistons are furnished for pumping water and the snap-ring type is furnished for pumping oil. The liners, which are removable and replaceable, are flanged

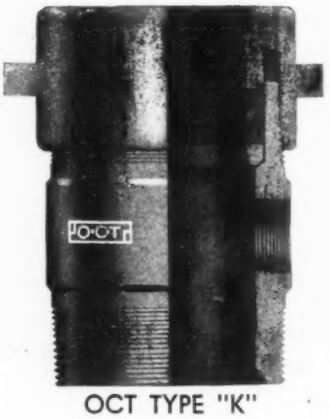
(Continued on Page 151)



OCT TYPE "L"

KEEPING AHEAD
of the field in
BRADENHEAD
DESIGN

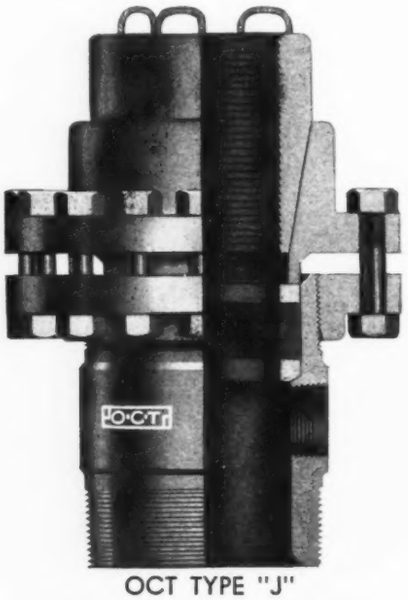
Assuring Blowout Preventer Protection Until Cement is Dry



OCT TYPE "K"

Type "L" packs off on casing with one set of packing, and around casing collar with another set, which permits repacking around casing collar under pressure. Upper and lower ends of main body have same size A.P.I. casing threads to permit screwing bradenhead on casing and screwing blowout preventer on top of bradenhead before running inner casing, and cementing it. Blowout preventer is thus closed around inner string while cement is drying. Hydraulic or asbestos packing furnished. It's cold water tested up to 5000 pounds.

Type "K" is a duplicate of Type "L" except that it doesn't seal around casing collar, and is therefore not repackable under pressure.



OCT TYPE "J"

Showing size 10¾" O.D. to 7" O.D. with two 3" gas outlets.

Type "J" (slip suspension bradenhead) is forged steel throughout except the slip bowl, which is cast chrome nickel steel. Threading arrangement on top and bottom of main body offers same advantages as Type "L," to permit blowout preventer to be closed around inner string while cement is drying.

Write for Bradenhead Section of O-C-T Catalog

O-C-T BRADENHEADS SOLD THROUGH LEADING SUPPLY STORES

OIL CENTER TOOL CO.
QUALITY O·C·T PRODUCTS
HOUSTON, TEXAS, U.S.A.
Cable Address: OCENTOL

(Continued from Page 150)

and held in place by the cylinder heads. Close-grained cast-iron liners are standard equipment but bronze liners can be furnished. In addition to the regular 4-in. liners, 3½-in. and 3-in. diameter liners can be used. An individual cylinder head of heavy construction is provided for each fluid cylinder.

The steam end of the pump is of sturdy construction and is recommended for a maximum steam working pressure of 250 lb. per sq. inch. Both steam cylinders and the cradle are integral parts of a close-grained iron casting which also includes the steam passages, valve surfaces, cradle-end cylinder heads, steam piston rod stuffing boxes, supporting feet and the steam inlet and exhaust connections.

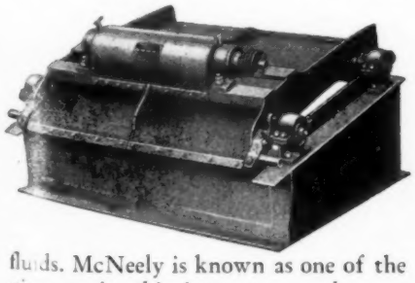
Each of the cast-iron steam pistons is equipped with two wide, step-cut piston rings. The steam valves are of the slide type and reinforced for heavy-duty service. The valve chest is heavily constructed and is held in place by six large stud bolts.

The heavy-duty valve gear includes a strong rocker-arm stand, drop-forged rocker arms, drop-forged rocker-arm shafts with integral cranks, heat-treated links, heat-treated link pins and double-guided heat-treated valve rods. Drilled holes in the rocker-arm stand, links and valve-rod glands facilitate oil lubrication of the valve gear.

Both the steam and fluid piston rods are ground and polished high-carbon steel. They are threaded into spool-type, heat-treated steel crossheads, where they are held tightly by lock nuts. The piston rods are tapered to fit the pistons. The stuffing boxes are extra deep and the adjusting nuts are located so that the glands can be taken up easily.

McNeely Vibrating Screen

VERNON TOOL COMPANY, Ltd., of 2740 East Thirty-seventh Street, Los Angeles, has announced an improved mud screen that is being marketed under the name of the McNeely Vibrating Screen. The new product is the outgrowth of the extensive experience of J. W. McNeely in the screening and reclaiming of rotary drilling fluids. McNeely is known as one of the pioneers in this important and comparatively new field.



The McNeely Screen is featured by simple design and sturdy, compact all-steel construction. It is an exceptionally dependable and efficient machine, the manufacturers state. The vibrating force, developed by an unbalanced shaft, is transmitted equally to all points on the screening surface, eliminating dead spots. The screen cloth fits absolutely tight on a curved frame and cannot flex or whip. The curved screen surface, an exclusive McNeely feature, facilitates the rapid disposal of waste cuttings. Under favorable conditions the McNeely Screen has a capacity of approximately 700 gal. of drilling fluid per minute, and may be driven by electric motor or steam turbine. Installation in the field is made easy, as the screen is built as a unit, requiring a minimum of headroom. Moving from one location to another is equally convenient.

The manufacturers have available an eight-page illustrated bulletin covering in detail the advantages derived from screening, together with complete specifications and information on the McNeely Vibrating Screen. A copy of the bulletin will be mailed upon request.

Yes Sir!

HEAVING SHALE
in the
Gulf Coast
of Texas and Louisiana
and
SYLVAN SHALE
in
Oklahoma
is Being Successfully Drilled with COLOX

manufactured under exclusive license by

Geo. S. Mepham Corp.,
2001 Lynch Ave., East Saint Louis, Ill. for Mid-Continent and Gulf Coast areas and

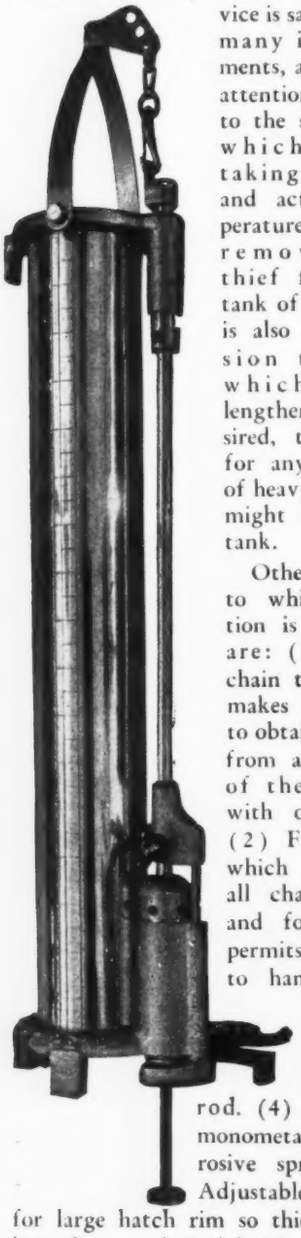
C. K. Williams & Co.,
of California, Ltd., Shellmound Park, Emeryville for Pacific Coast area
Under U.S. Patents Nos. 1,575,944-5

COLOX
COLLOIDAL IRON OXIDE

Distributed by The Republic Supply Co., in the Mid-Continent and Gulf Coast areas

Many Important Features Distinguish New Oil Thief

IT MAY sound queer to refer to a thief as something you can trust, but such is the claim made for the Tulsa Oil Thief, distributed by the W. L. Walker Company, Inc., 800 South Main Street, Tulsa, Oklahoma. The device is said to offer many improvements, and special attention is called to the side hook, which permits taking gravity and actual temperatures without removing the thief from the tank of oil. There is also an extension trip rod which can be lengthened, if desired, to provide for any quantity of heavy B.S. that might be in the tank.



Other features to which attention is directed are: (1) Single chain trip, which makes it possible to obtain a sample from any section of the oil tank with one chain. (2) Flat bale, which eliminates all chain sliding and fouling and permits the thief to hang plumb. (3) Graduated non-sparking extension rod. (4) Enclosed monometal non-corrosive springs. (5) Adjustable side hook for large hatch rim so thief may be brought any desired height above the thief hatch for taking gravity. (6) Rotary valve, which eliminates scoring by sand and at the same time provides perfect seating.

The Tulsa Oil Thief is provided with cast bronze rings at top and bottom, which are pressed onto the tubing against turned shoulders. The tube is then expanded and the bale pins at the top are riveted through the top ring and tube, eliminating any chance of losing the thief in the tank.

Williams' "Boll-Weevil" Tongs Display

THE ACCOMPANYING illustration shows the "Boll-Weevil" display board of J. H. Williams & Co., 75 Spring Street, New York City. The mechanical arm operates the tong exactly as in actual service. First a series of six bites are taken on the rotating pipe section demonstrating the action of the tongs in making up pipe. During this operation the caption "Making Up" is illuminated. At about the fifth stroke the caption "Watch Action Reverse" illuminates and the tong shifts over into the position illustrated in the photograph and the mechanical arm lifts up on the handle, demonstrating the breaking out action of the tongs. During this period caption "Breaking Out" is illuminated. In operation the action of the tongs is exactly as it would be in the hands of an operator.

Lunkenheimer Gauge

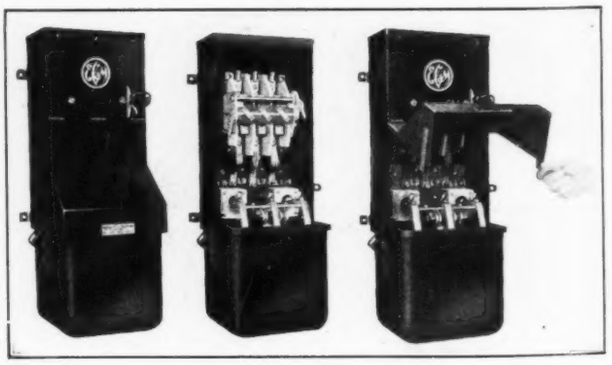
THE LUNKENHEIMER COMPANY of Cincinnati, Ohio, has made a change in design in Fig. 1183 Automatic Liquid Gauge. All internal working parts—stem, gland, retaining ring, stuffing box washers and ball checks—are now made of stainless steel, to provide maximum resistance to corrosion and eliminate sticking. The new pressure rating is 350 lb. G. L. P. (Gas-Liquid) at 450 deg. fahrenheit.

The new Fig. 1183 is adapted for use on pressure tanks, gravity tanks and other reservoirs handling liquids which attack brass or bronze.

Dependability and safety are insured by the exceptionally sturdy construction; automatic closure of ball checks in both upper and lower valves in the event of glass breakage; non-corrodible and non-sticking working parts; easy and safe replacement of new glasses; cone-shaped packings which prevent leakage around glass and minimize glass breakage due to over-packing and torsional strains; reduced fire and accident hazard; standard pipe plug in lower valve body for drain connection. Booklet F-586 will be sent upon request.

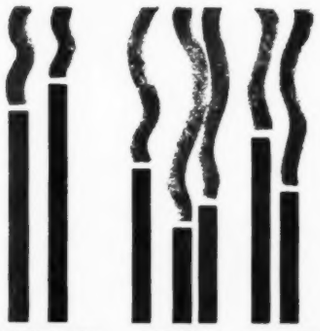
E. C. & M.'s Magnetic Starter

FOR MOTORS up to 30 hp., 220 volts, 60-hp., 440 volts, and 75-hp., 550 volts, the Electric Controller and Manufacturing Company, 2708 East 79th Street, Cleveland, Ohio, announces the EC & M No. 2 Type ZOS oil-immersed, across-the-line, combination magnetic starter. This starter, a larger companion for the No. 1 Type ZOS starter, contains an unfused or fusible safety switch and a magnetic starter with overload relays. All the internal wiring of these starters is complete.



Although designed for severe service, these starters are exceptionally small and narrow, having safety switch front operated and a cover that swings vertically. This makes them especially desirable for mounting in restricted spaces such as between the flanges of columns, for mounting on motor-driven machines or many starters closely grouped along a wall.

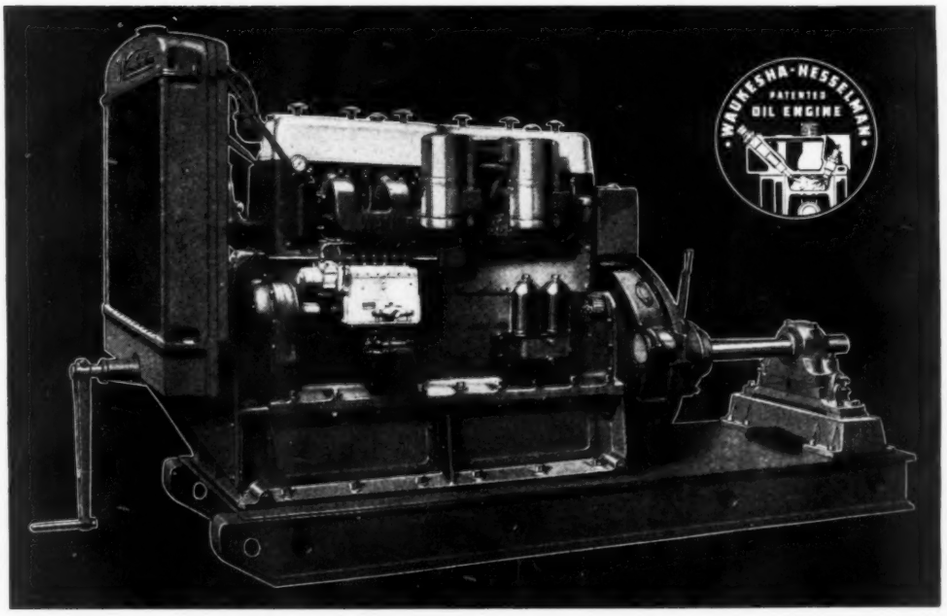
Extremely sturdy construction is used throughout these starters. Safety switches have wiping wedge, double-break contacts, heavy-gauge steel parts with all actuating parts case-hardened. Magnetic starters have bushed arm bearings, highly efficient magnetic circuits, making them exceptionally quiet in operation with larger-than-average clearances between live parts and high arc rupturing capacity. Overload relays are accurately designed to provide sensitive overload protection.



Every factory stack is smoking . . . .

WAUKESHA IS WORKING EVERY DAY

The new Waukesha-Hesselman oil field engine is one reason for the factory's activity. 150 hp. to 175 hp., six cylinders . . burns cheap Diesel fuels by solid injection, but uses electric ignition. Cylinder pressures are no higher than gasoline engine cylinder pressures. And for ease of starting, acceleration, and



power delivered its performance is on a par with gasoline units of the same size. Yet its fuel cost is less than one-half that of gasoline. • Write for Bulletin 1000—it tells about all the Waukesha-Hesselman Oil Field Engines. Waukesha Motor Company, Waukesha, Wisconsin.

WAUKESHA ENGINES

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

"Dear, I saw the sweetest, cleverest little hat downtown today."

"Put it on, let's see how you look in it."—*Grinnell Malteaser.*

* * *

Two chorus boys had a feud and they finally came to blows.

The result of the battle is that one has a cauliflower wrist.

—*N. Y. U. Medley.*

* * *

He: Baby, I can read you like a book.

She: O. K. but lay off the Braille method.—*Cornell Widow.*

* * *

Curious Old Lady: Why, you've lost your leg, haven't you?

Cripple: Well, damned if I haven't.

—*Arizona Kitty Kat.*

* * *

Don't you always pity a girl who is frightened in the dark?

Yeah, I can't help feeling for her.

—*Lufkin Line.*

* * *

LOVE IN THE ORCHESTRA

"Viola, I love you. I want you tuba mine. I lay my harp at your feet."

"Aw, quit stringing me along. You don't get to first bass with me."

"Say not this: 'I'm tired of playing second fiddle!' You've got too many guys bowing you around."

"Oh, what a violin sinuation! What brass! Why did you piccolo thing like that to say to me? I ought to give you a baton the head!"

"Yeah? Gee, I'm trebling all over!"

"You'd better tremolo-ver what you said. I'm liable to drum you yet."

"Oh, but suite, let's give this a rest."

"Oh! Trying to snare me in double quick time, eh? Well, quit horning in. Gwan! Blow!"

"Well, fife not been a chump! After all the do I've spent a music you! That's a scaly trick!"

"Say, I'm tired of listening to your chorus language. You're not so sharp. I'm leaving you flat!"

"Well, I'll be——!" (What, B b?)

—*Colo. Dodo.*

* * *

"So you want a divorce from your wife. Aren't your relations pleasant?"

"Mine are, but hers are simply terrible."

WHAT? NO PEANUTS?

"Are you positive that the defendant was drunk?' asked the judge.

"No doubt," growled the officer.

"Why are you so certain?"

"Well," replied the officer, "I saw him put a penny in the patrol box on Fourth Street, then look up at the clock on the Presbyterian Church and shout: 'Gawd, I've lost fourteen pounds!' "

—*Lehigh Burr.*

* * *

He: Had a date with a World's Fair girl last night.

Second: How's that?

He: If I had spent a century I wouldn't have made any progress.

—*Nebraska Awgwan.*

* * *

Golfer: Caddy, is the Major out of that bunker yet? How many strokes has he taken?

Caddy: Seventeen niblick and one apoplectic, sir.—*Arizona Kitty Kat.*

* * *

As I stepped up to the lonesome lady in the hotel lobby, I inquired, "Are you looking for a particular person?"

"I'm satisfied," she said, "if you are."—*Annapolis Log.*

* * *

"I'd have that tooth pulled out if it was mine."

"So would I, if it was yours."

* * *

Guide: On our right we have the palatial home of Mr. Gould.

Old Lady: John Jay Gould?

Guide: No, Arthur Gould. And on the left is the residence of Mr. Vanderbilt.

Old Lady: Cornelius Vanderbilt?

Guide: No, Reginald Vanderbilt. And in front is the First Church of Christ. (To Old Lady): Now's your chance.

* * *

Binks (phoning down from his room): Night Clerk?

Snippy Clerk: Well, what's biting you?

Binks: That's what I want to know.

* * *

"C'mon, let's go to a movie."

"Nah, I've seen all the Roosevelts before."—*Penn. Punch Bowl.*

Iceman (entering kitchen with cake of ice): Hello, sonny.

Little Boy: Hey; when you call me that, smile.—*Syracuse Orange Peel.*

* * *

When a baby gnu was born in the San Francisco zoo, George Bistany, the superintendent, called up the city editor of a local paper to report it. The city editor understood Bistany to say: "We have some news about the news."

"Do you mean it's new news?" asked the city editor.

"Yes," said Bistany, "new news about the new gnu."

"But all news is new."

"Oh, we have some old gnus here, but I want to give you some new gnu news about the new gnu that our old gnus have."

"Will you please," pleaded the city editor, "write it and send it in?"

Bistany did, and his note said: "I was trying to give you some gnu news about our two old gnus that have a baby gnu. Both the old gnus and the new gnu are doing very well."

—*Wall Street Journal.*

* * *

A negro boy, going through a cemetary, read this inscription on a tombstone: "Not dead, but sleeping."

Scratching his head a while the boy remarked: "He sure ain't foolin' nobody but hisself."

* * *

Vance E. Rowe, chief scout of the Carter Oil Company, made his first thorough tour of Texas recently and came home expressing real surprise at the size of the Lone Star State. At Houston he overheard this tale:

"Two friends met on the street. They shook hands and one spoke up: 'Where have you been, Bill?' 'Up north,' the other replied, and the first asked, 'How far north did you go?' 'Oh, up among those Yankees in Dallas,' was the answer."—*Tulsa World.*

* * *

Daisy: Have you known the boss very long?

Maisie: Yes, I've known him since I was in high school—the old horse's neck.

Daisy: Huh, I've known him further back than that.

—*Bridgeport Bulletin.*

Send for a sample of

LAY·SET PREFORMED ROTARY LINE

AND MAKE IT SELL ITSELF!

● The coupon below will bring you a sample length of LAY-SET Preformed Rotary Line. Send for that sample today and make it sell itself—in the privacy of your office, at your convenience.

When you receive your sample, take it apart, then put it together again, as illustrated. By this simple test LAY-SET will prove how the preforming process—

. . . does away with all internal stress . . . resists kinking . . . makes every wire carry its full load . . . cuts the time costs of replacement . . . makes broken wires lie flat . . . eliminates the necessity for seizing . . . makes LAY-SET last longer.

LAY-SET Preformed Rotary Lines have revolutionized all old ideas of wire rope service and economy. Send for a sample of LAY-SET and a copy of the new booklet "12 Burning Questions." Sign and return the coupon right now.

HAZARD WIRE ROPE COMPANY
Wilkes-Barre, Pennsylvania

New York · Pittsburgh · Denver · Chicago · Ft. Worth · Tacoma
Los Angeles · San Francisco · Atlanta · Philadelphia

HAZARD LAY-SET PREFORMED* ROTARY LINES

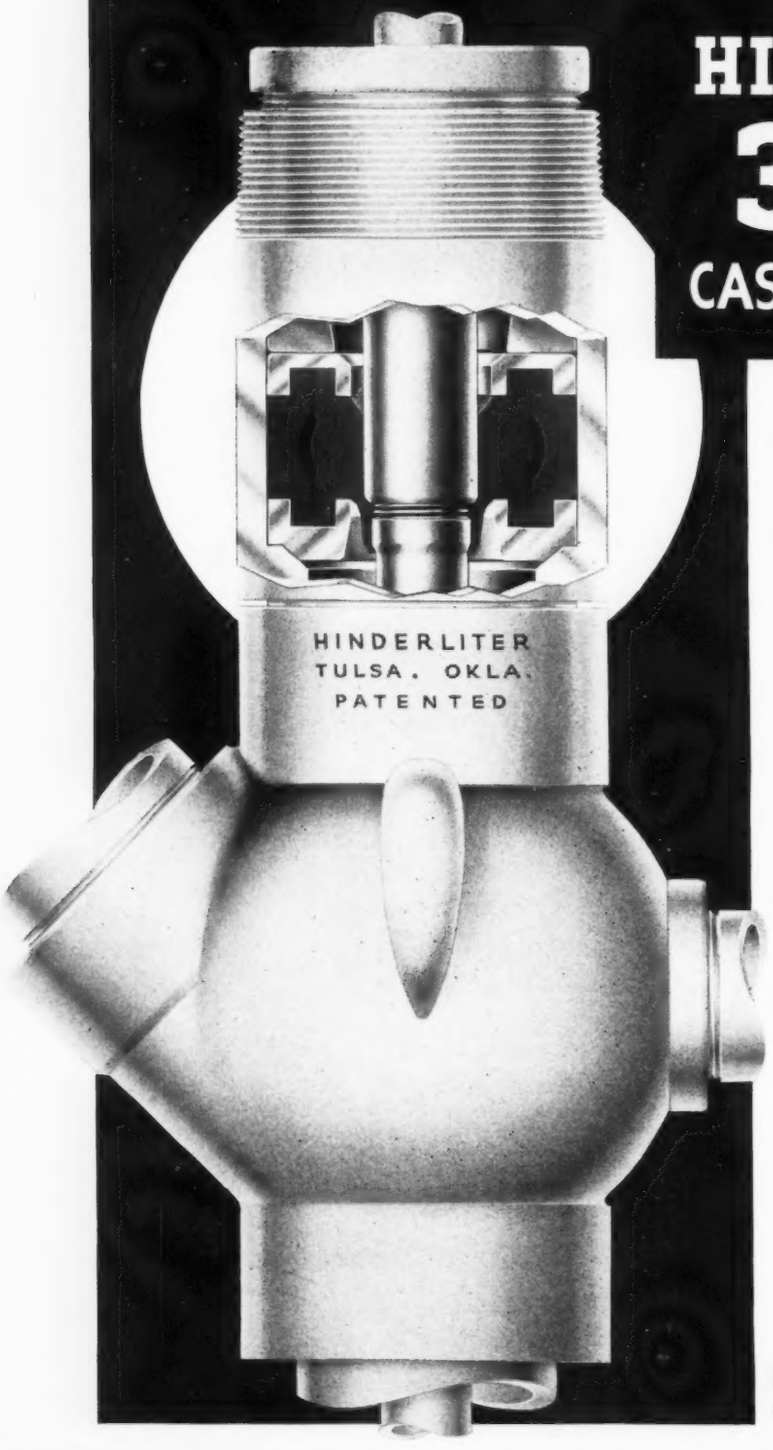
HAZARD WIRE ROPE COMPANY, Wilkes-Barre, Pa.
Send me a sample length of LAY-SET Preformed Rotary Line and a copy of your book "12 Burning Questions." No obligation, of course.

Name.....
Firm.....
Address.....

*PREFORMING IS A PATENTED MANUFACTURING PROCESS APPLICABLE TO ANY TYPE, GRADE, CONSTRUCTION AND LAY OF WIRE ROPE

Another Achievement!

THE HINDERLITER 3-IN-1 CASINGHEAD HOOK-UP



You can now lower or remove well tubing or casing UNDER PRESSURE without loss of pressure or fluid.

The Hinderliter 3-in-1 Casinghead Hook-Up is really THREE tools combined in one—designed for use in the process of drilling—in the process of bringing in wells—and in the process of maintenance. It permits well tubing or casing to be run, under pressure, in a minimum of time without loss of gas or oil. When a Hinderliter 3-in-1 Casinghead Hook-Up is installed on a well, no special fittings, equipment or operators are necessary to run the tubing, and the danger of a blow-out is eliminated. This unit can be used in combination or connection with standard fittings and devices.

Many installations of the Hinderliter 3-in-1 Casinghead Hook-Up in high-pressure fields have proven that it is the most efficient tool, for its purpose, ever designed . . . by cutting tubing time . . . saving oil and gas . . . eliminating need of special equipment . . . and increasing the safety factor . . . it is definitely reducing the cost of production.

For complete details on the 3-in-1 Casinghead Hook-Up see any leading supply house or write direct to . . .

HINDERLITER TOOL COMPANY
1150 No. Peoria, Tulsa, Oklahoma

HINDERLITER

STRANGE.... *but* TRUE

HAPPENINGS IN THE PETROLEUM INDUSTRY

In addition to being the largest user of tank cars, the petroleum industry is the largest user of tank vessels. The oil tanker today constitutes one-sixth of our merchant tonnage on the high seas.
JACOB RUPPERT
Petroleum Products Carried by ADMIRAL BYRD on his EXPEDITION
200 GALS. DIESEL ENGINE LUBRICATING OIL
800 GALLONS LUBRICATING OIL
250 GALS. ROD SWABBING OIL
1,500 GALS. KEROSENE
6,250 GALS. MARINE ENGINE OIL
3,000 GALS. GASOLINE
15 LBS. AERO ROCKER ARM GREASE
30 TONS DIESEL ENGINE FUEL OIL
14,950 GALS AVIATION GAS
600 GALS. CYLINDER OIL
400 LBS. CUP GREASE
5,964 GALS. FUEL OIL
A survey reveals that the State of Texas has 48,391 oil wells, each producing an average of 18.2 bbl. daily.
Old-time oil men of the Osage, (Osage County, Oklahoma) on foot were sometimes chased up trees by the cattle.

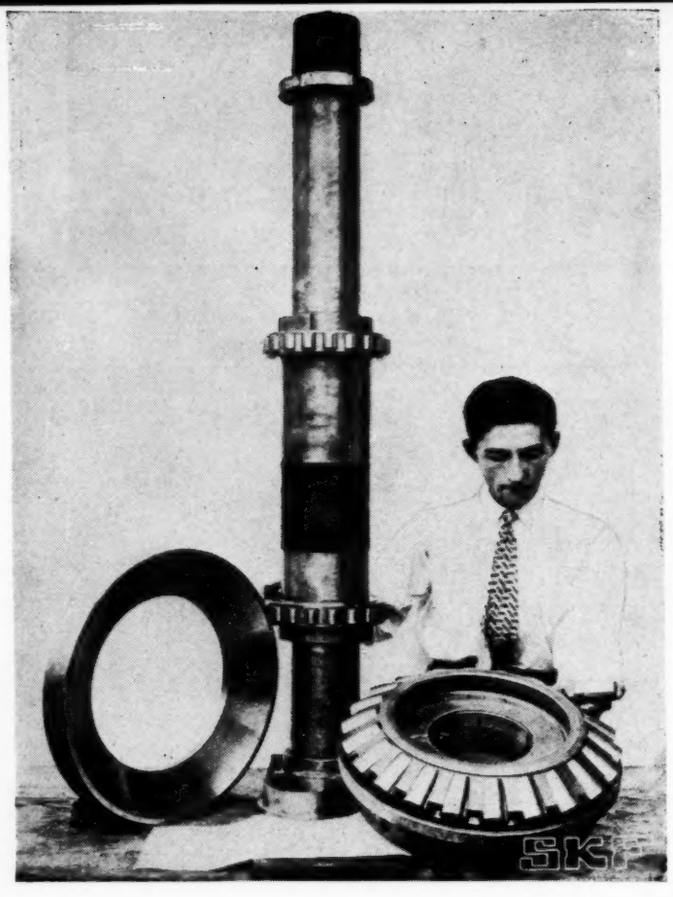


Fig. 1. Antifriction bearings used on a rotary swivel

Anti-Friction Bearings in Oil Field Equipment

By OTTO NEUMER
Petroleum Engineering Division
SKF Industries, Inc.

ANTIFRICTION bearings have accomplished their greatest strides in the oil industry — especially in deep-well drilling equipment — during the last decade. They have overcome problems encountered on rugged, sometimes crude, machines where no attention was paid to requirements. Precision methods were not generally followed, as the idea of ruggedness seems to have pervaded the entire industry. The machines usually were not built according to modern production methods but were made to suit individual needs with the result there are many variations in different machines that accomplish the same purpose.

At first, size and strength were considered synonymous, but today the builder of oilfield equipment realizes that *refinement* and strength can be combined to make a more efficient unit. Here is where the antifriction bearing has come to his assistance with increased efficiency and more compact design.

There are two kinds of bearings used in the oil fields — plain and antifriction. Among the antifriction bearing types are ball, roller and thrust, each designed for a different purpose, dictated by its application for radial and (or) thrust loads.

The plain bearing has performed for many years, supporting moving parts under heavy loads, and has seen the oil man through his pioneer problems.

The antifriction bearing, having all the capabilities of the plain bearing and other advantages, is qualified to carry on work begun by the pioneer. It saves possibly as much as 25 per cent in power formerly lost through friction; and as far as loads are concerned, it stands up under hundreds of thousands of pounds in an atmosphere filled with dust and moisture, and keeps going over long periods without attention because it carries the load on a metal-to-metal contact.

The self-aligning bearing combines qualities of the plain bearing and the antifriction bearing. This means the bearing aligns itself without the aid of exterior aligning surfaces, compensates for shaft deflection, eliminates the need of adjustments, factors that slice labor and maintenance costs to the bone.

Dead-load capacities of deep-well rigs or derricks in the Oklahoma City field have risen from 3,000 to about 1,000,000 pounds. As these loads must be carried by the crown blocks and are an indication of the capacity of the derrick, equipment involves heavy duty design throughout. This, naturally, demands dependable antifriction bearings that can stand up under heavy loads.

Take the self-aligning antifriction spherical roller thrust bearing, for instance. It has inherent self-alignment that enables it to support tremendous loads encountered in deep-well drilling. One swivel, equipped with antifriction bearings, is drilling its third hole, averaging 6500 ft. per hole, and is still going strong; which speaks well for bearings that withstand the whipping the swivel receives from the drill pipe.

Fig. 1 shows the design of the rotary swivel. The drill stem is carried by the spherical roller bearing mounted on a sleeve through which the mud passes. Upward shock loads are taken by a single thrust bearing, and the sleeve guided radially by two cylindrical roller bearings.

Nobody wants to climb the derrick to grease the crown block; this work is eliminated by installing cyindrical roller bearings. These bearings will run for months without any attention, and, due to their compact design, save overall length along the shaft.

Between the engine or motor and the rotary table are power take-off shafts, countershafts or drawworks all of which can be profitably mounted on anifriction bearings as some of the leading manufacturers have shown. Even the steam engine, electric motor, and Diesel engine have been introduced to antifriction bearings.

For a long time rotary tables and driving shafts have been satisfactorily run on antifriction bearings. Emsco and Lucey, two of the largest oil equipment manufacturers in the country, have been using self-aligning roller bearings on the pinion shaft. Two bearings are pressed on the shaft against shoulders and held by a sleeve between the pinion and the inner race of the bearing. The speed is around 300 r.p.m., and shock loads, though of indeterminate value, are carried without any arouble.

Pumping units, regarded as a necessary evil when gushers change their status by failing to flow, have today reached a point of prime importance with machinery builders. Take a look at what is happening in the East Texas fields, where $58,000,000 is estimated for pump equipment alone.

Old pump units with countershafts and belt drives are gradually giving way to highly efficient units that include gear reductions mounted on roller bearings. In these units, as well as in modern geared pumping powers, we have an out-

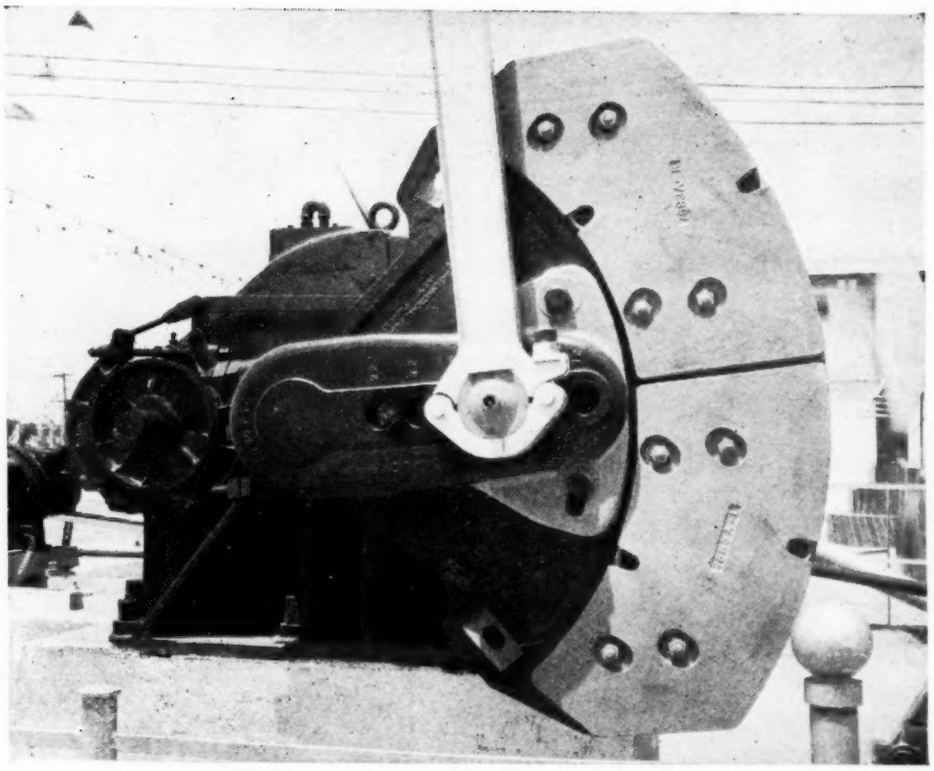


Fig. 2. Wrist-pin bearings equipped with SKF spherical bearings. This pitman is on a 100-hp. geared pumping unit

standing example of the long road that the machinery builder has traveled from the first crude machines. Pumping units should run continually without attention; this is something that only the antifriction bearing can insure.

Even the pitman on pumping rigs has been successfully mounted on self-aligning roller bearings by Ideco (see Fig. 2) and others. The angular deflection that occurs at the wrist pin immediately suggest the use of the self-aligning bearing.

These applications have helped to increase efficiency. Their rapidly-growing number is evidence that a new era in oilfield equipment is rolling forward on antifriction bearings.

WINTER GALVESTON! THE TEXAS RIVIERA

AFFILIATED WITH THE National hotels A NEW ERA IN SOUTHERN HOSPITALITY

Galveston offers the winter vacationist an unusual opportunity in an ideally located hotel directly on the beach. Rooms or suites of sizes suitable for the individual guest or for the entire family are available at most moderate rates. Enjoy the luxury of a winter vacation or week-end on tropical Pleasure Isle, enhanced by a cheerful room with pleasant service. The climate and salt air offer relief to Hay Fever sufferers.

WINTER RATES NOW IN EFFECT!

THE BUCCANEER HOTEL

ON THE BEACH · GALVESTON TEXAS

We Use

DAY and NIGHT TOURS

to Give You Fast Service

On Typography and Composition

- The typography facilities of this plant, with co-operating connections for electrotypes, enables us to turn out complete plates from rush copy.
- Many major oil companies have us set their advertisements because the typography is distinctive, the service is fast and the location for distribution of electros is convenient.
- Visitors to the A.P.I. meeting with advertising and printing production problems are invited to visit our plant, day or night.

Jaggars · Chiles · Stovall · Inc.

Advertising Typography

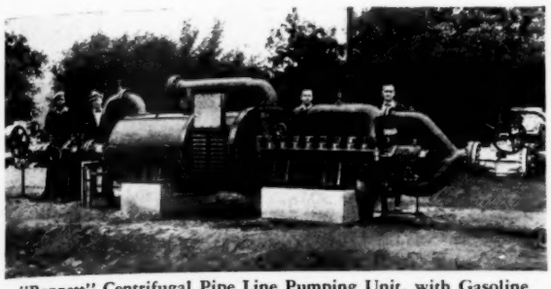
1306 Marilla Street

Dallas, Texas

OFFICERS OF AMERICAN PETROLEUM INSTITUTE

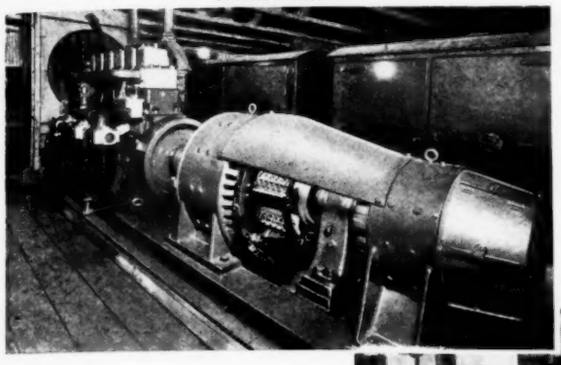
Axtell J. Byles, President; W. R. Boyd, Jr., Executive Vice-President; Charles F. Roeser, Vice-President for Production; Howard Bennette, Vice-President for Refining; Charles E. Arnott, Vice-President for Marketing; K. R. Kingsbury, Vice-President at Large; Herbert L. Pratt, Treasurer; Lacey Walker, Secretary and Assistant Treasurer; Carl A. Young, Secretary, Division of Production.

Modern Equipment for the Oil Industry!



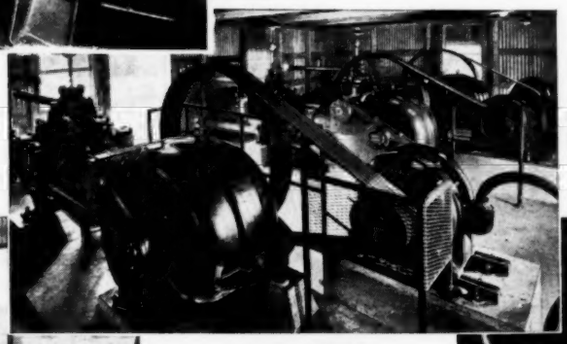
"Rannett" Centrifugal Pipe Line Pumping Unit, with Gasoline Cooled Motor.

ALLIS-CHALMERS motors, with their steel frames, triple impregnated windings and indestructible rotors, are working at every sort of job in connection with drilling, pumping and transportation. They include multi-rated, constant speed types for pumping and drilling, variable speed types, splash-proof motors, enclosed fan-cooled motors, explosion-proof motors and gearmotors, as well as standard general purpose types for driving pumps, compressors, etc. ● Direct current electric drives for rotary drilling combine the desirable characteristics of the steam engine, the fineness of control of the direct current motor and the economies of the internal combustion engine. ● Positive and flexible Allis-Chalmers Texrope drives are used on slush pumps, pipe line pumps, compressors and many other types of equipment. ● Allis-Chalmers motor-driven centrifugal pumping units are used in every branch of the petroleum industry . . . gathering . . . pipe line pumping . . . refining. ● Rotary compressors of the multi-cellular sliding vane type are built for volumes from 50 to 2000 c.f.m. at pressures up to 150 lbs. They are used for low pressure air and gas lift and repressuring, for gas booster service and for air agitation work in refineries.



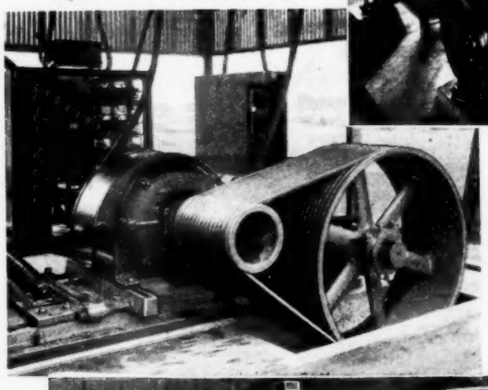
Above: Main Generator and Control Cabinets of D-C Electric Drilling Rig.

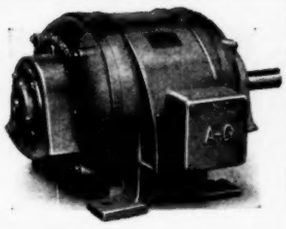
Below: Wound Rotor Motor, Single Reduction Unit and Texrope Drive coupled to Rotary Drilling Rig.

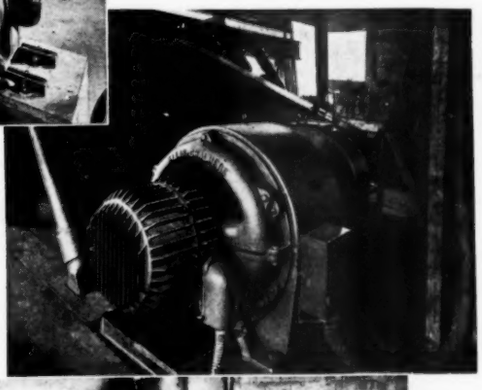


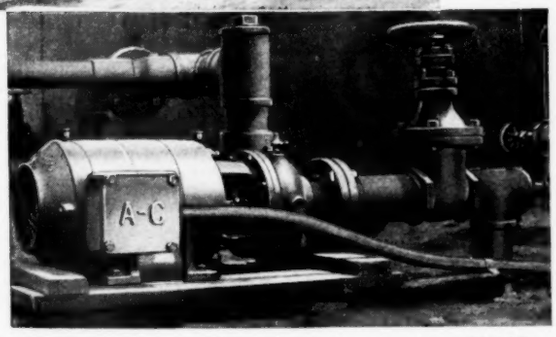
Left: General Purpose Squirrel Cage Motors and Texrope Drives operating Slush Pumps.

Below: 250/85-hp. Wound Rotor Motor for Rotary Drilling.

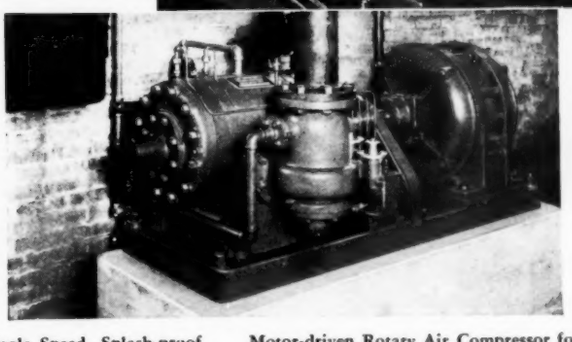








Explosion-Proof Motor and Close Coupled Pump.



Above: Multi-Rated, Single Speed, Splash-proof Squirrel Cage Pumping Motor.

Motor-driven Rotary Air Compressor for Air and Gas Lift, Agitation of Oil, etc.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

Reducing Underreamer Costs

WHETHER you own and operate your own underreamers or rent them, your underreamer costs can be reduced materially, in most instances, by observing a few simple and practical rules with reference to keeping the underreamer body in proper operating condition. Cutter breakage, with either the regular type or the new type Swan underreamers, for example, can be reduced to the minimum by observing the instructions herewith.

UNDERREAMER SIZE	WEAR AT "A"
4½	1/16
5 3/16	1/16
6¼	3/32
6 5/8	3/32
8¼	1/8
10	3/16
12½	¼
15½	¼

REGULAR TYPE SWAN

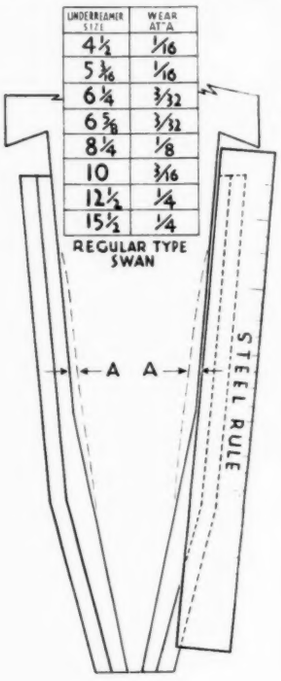


Fig. 1

The principal points of wear on the regular type are indicated by the dotted lines at "A", Fig. 1. If the underreamer is used after these bearing surfaces have worn excessively, breakage of cutters is sure to result. Wear at this point of the body obviously throws the cutters out of position, causing the main force of the underreaming blow to be taken on the edges of the cutter and body slides. This causes the lip of both the cutter and the underreamer body to break. Fig. 1 illustrates how to measure correctly and accurately the amount of wear at "A." When this wear reaches the amounts stated in the table, the underreamer should be built up. To continue to run it will cause unnecessary cutter and body expense in repairs. It will be noted from the chart that the amount of wear permissible varies with the size of the underreamer. For instance, a 4½-in. Swan should be repaired when the body has worn 1/16 in. at "A", while the larger sizes are safe to run until the wear is as much as ¼ inch.

UNDERREAMER SIZE	A	B
4½	2¼	2⅛
5 3/16	2 9/16	2⅛
6¼	3 1/32	2¼
6 5/8	3 9/32	3
8¼	4 13/64	4
10	5	4 5/16
12½	5¼	5 5/16
15½	6⅜	6½

NEW TYPE SWAN

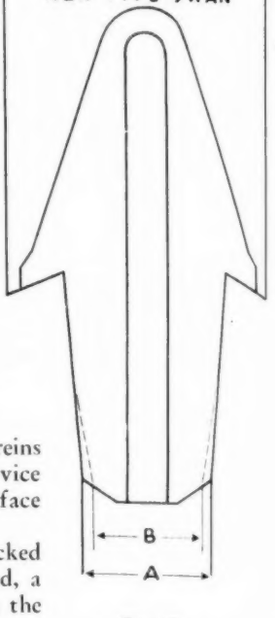


Fig. 2

Fig. 2 shows the principal points of wear on the new type underreamers of this make. The method of measuring the wear on this tool is somewhat different, but equally simple. "A" indicates the width at the end of the body of a new tool, "B" the maximum amount of wear that should be permitted before repairing the tool. When the end of the underreamer is worn down smaller than the dimensions under "B" in the table, a severe strain is placed on the reins of the cutters at every underreaming blow. This causes the reins to break long before the full service is obtained from the cutting surface of the cutters.

If these measurements are checked carefully and these rules observed, a considerable saving will result in the cost of underreamer repairs.

Drilling Operations in Hanover, Germany, Oil Fields Show Increase

Drilling operations in the oil fields of Hanover, Germany, during the first six months of 1934 showed a fair increase compared with the corresponding period of 1933. The authorities are encouraging the exploitation of the Hanover fields, in view of the present oil resources not being nearly sufficient for domestic needs. This assistance is said to be given in the form of long term credits to the oil companies concerned.

It is reported that the increased drilling operations have largely been carried out in the Nienhagen-Hanigsen field in Hanover, the principal oil producing center in Germany. During the first half of the current year the production of crude oil in the Nienhagen-Hanigsen field showed an increase of approximately 58 per cent compared with the corresponding period of 1933. The drilling operations in this field are being carried out by the Gewerkschaft Elwerath, Hanover, the Gewerkschaft Krug von Nidda, Celle, the Internationale Tiefbohr A.G., Celle, and the Deutsche Vacuum Oel A.G., all of which companies have been successful in opening up new oil wells at depths ranging from 1,000 to 2,000 meters.

It is estimated that at the present rate of production and drilling operations the total quantities of oil produced in the province in 1934 will be approximately 300,000 metric tons, assuming that the second half of the year will show slightly better results than the first half, which was not the case a year ago.

The production of oil in the province of Hanover during the first six months of the current year showed gradual improvement and totaled 132,805 metric tons, compared with 106,601 tons in the corresponding months of 1933, thus showing an increase of approximately 25 per cent.

England's Hopes of Oil Wealth Revived

West Somerset is following with keen interest the recent attempt on the part of the government to enact a bill with the object of encouraging the search for oil in Great Britain. Somerset is known to be one of the wealthiest counties in the country for oil-bearing shale, and recently experiments have been made at Kilve, near Bridgwater, where it is estimated there are over 9,000,000,000 tons of oil shale for treatment.

Ten years ago high hopes were entertained of placing the Somerset oil deposits on a commercial basis. At that time a survey and tests showed that over a stretch of country nearly ten miles in length and about two and one-half miles in breadth there was nothing but shale beneath, covered for the most part with a thin layer of soil. Moreover, it extended to a depth of about 1,000 feet. The oil-bearing shale was available for working at a small cost as there was no need for mining.

Subsequent developments led to the formation of the Williton Syndicate, which, after obtaining the necessary options, proceeded to erect an extracting kiln on the shore near Kilve. Apparently, however, investors had little faith in the undertaking, and, the necessary capital not being forthcoming, the project was abandoned. In due course the funds of the syndicate became exhausted, and with the closing down of the kiln any hope of the development of the oil shales disappeared.

Carbondale and Worthington Consolidate in Refrigeration Field

Announcement is made of the consolidation of interests of the Carbondale Machine Company, of Carbondale, Pennsylvania, with those of the Worthington Pump and Machinery Corporation, Harrison, New Jersey, in the general refrigeration field, operating in the future as the Carbondale Machine Corporation.

The Carbondale Machine Corporation will transfer all necessary personnel and equipment to Harrison, New Jersey, and will build its lines of machinery at the Worthington plants.

Harnischfeger Publishes Anniversary Book

This year, as it passes the half century mark, the Harnischfeger Corporation of Milwaukee, Wisconsin, has published an attractive anniversary book entitled: "The Fiftieth Year."

Bound in gold and purple, and profusely illustrated throughout its 84

pages, this book is one of the most elaborate of its kind to appear in recent years. It tells the story of an organization that has grown in the American tradition, its small beginning, its early struggles against all manner of hardship, and its pioneering of many types of equipment.

Back in the early '80s, two young partners in Milwaukee opened their machine shop and began studying the needs of engineers, builders, and industrialists. That background of manufacturing experience stood them in good stead when they later developed the excavating and material handling equipment now known under the trade name of P&H.

The story told in the book "The Fiftieth Year" is that of a group of pioneers who have woven their own achievements into the American industrial fabric through their contributions in the field of power equipment. Copies are being presented to friends and patrons of the Harnischfeger Corporation as a greeting on the company's golden anniversary. Executives desiring copies will receive them by addressing a request on company stationery to the Harnischfeger Corporation, Milwaukee.

Five Safety Awards to Socony-Vacuum

Five major awards for industrial safety and accident prevention were given to the Socony-Vacuum Oil Company, Inc., and its affiliated companies at the National Safety Congress recently held in Cleveland. These awards, it was announced, covered manufacturing, pipe line and natural gasoline departments for a six months' period.

The Socony-Vacuum companies recognized in the major awards of this Congress were the Oil Refineries at Paulsboro and Olean of the Socony-Vacuum Oil Company, Inc., Wadhams Oil Company, Milwaukee, Wisconsin; General Petroleum Corporation, Los Angeles, California (two awards), and the White Eagle Oil Corporation, Kansas City, Mo.

Willing to Lend....

and DOING it!

Since January 1, 1934, The First National Bank and Trust Company of Tulsa has made new loans (renewals excluded) aggregating $8,738,896.95 to 4,375 firms and persons.

This averages $34,678.16 for each business day.

More than 90 per cent of these loans were for amounts less than $5,000.

THE FIRST NATIONAL BANK and TRUST COMPANY TULSA

THE OIL BANK OF TULSA

F. S. Fales New Treasurer Socony-Vacuum Oil Company, Inc.

F. S. Fales is the new treasurer of the Socony-Vacuum Oil Company, Inc., succeeding Richard P. Tinsley who recently retired after 42 years of service. Fales has been identified with the company for 31 years. He joined the Standard Oil Company in 1903 as assistant manager of the manufacturing department. In 1919 he was elected director and also president of the Standard Transportation Company, a subsidiary in charge of the marine operations of this company. In 1932 he became president of the Standard Oil Company of New York, and following the merger with the Vacuum Oil Company, became vice-president and a director of Socony-Vacuum. He also is a member of the company's executive committee.

W. D. Bickham, the new secretary of the Socony-Vacuum Oil Company, Inc., was formerly assistant secretary, and prior to the merger, held a similar position with the Vacuum Oil Company.

Dr. von Schrenk New President A.S.T.M.

Dr. Hermann von Schrenk, St. Louis, Mo., consulting timber engineer, and senior vice-president of the American Society for Testing Materials, has been elected to the office of president. This action was taken by the executive committee to fill the vacancy caused by the death of W. H. Bassett who passed away on July 21, soon after he took office as head of the society.

The vacancy created by Doctor von Schrenk's election was filled by the appointment of H. S. Vassar as senior vice-president.

A. C. Fieldner, chief engineer, experiment stations division, U. S. Bureau of Mines, Washington, D. C., has been elected junior vice-president. No action was taken to fill the unexpired term of Fieldner as a member of the executive committee.

Westinghouse Electric Supply Company Announces Promotions

According to a recent announcement by F. A. Merrick, president of the Westinghouse Electric Supply Company, East Pittsburgh, Pennsylvania, Bonnell W. Clark has been appointed vice-president and general manager of that company, and H. N. Gansman and R. J. Holtermann, vice-presidents.

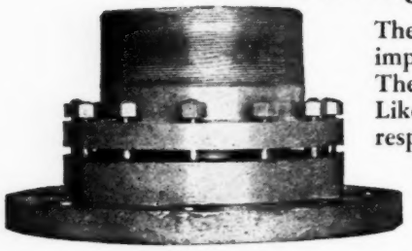
Clark joined the Westinghouse Commercial Investment Company as a special agent in 1925, later becoming assistant to the vice-president, and in 1927 receiving the appointment of general manager of that company. When the company name was changed to Westinghouse Electric Supply Company, he retained his position as general manager.

Gansman, upon graduation from the University of Pennsylvania with a degree in mechnical engineering, became an apprentice with the Westinghouse Electric and Manufacturing Company at East Pittsburgh. He has been with the Westinghouse company during its entire business career and, in 1920, when Westinghouse decided to build up a chain of distributing outlets, he was given the management of the first institution acquired. In 1931 he came to New York to become general sales manager of the Westinghouse Electric Supply Company. His headquarters are at 150 Varick Street, New York City, and his residence at 278 Harvey Street, Philadelphia, Pa.

R. J. Holtermann, whose headquarters are in the San Francisco offices of the Westinghouse Electric Supply Company, has spent his entire business career in the electrical supply business. He started with the Holabird & Reynolds Electrical Supply Company in San Francisco. This concern later became part of the Fobes Supply Company which, in 1923, was acquired by Westinghouse interests. In 1932 Holtermann was made district manager for the Westinghouse Electric Supply Company's entire operations west of the Rocky Mountains.

RECOGNIZE THE WELLS LISTED BELOW?

—*then you'll Recognize the Value of the Casing Head Which Protected Them*



Unassembled, showing recessed coupling, split rings, and top flange, with adapter gland.

The RECTOR SAFETY CASING HEAD played an important part in the drilling of every one of them. The list of users of this head is growing every week. Likewise, the safety and ease of handling pipe is correspondingly increasing.

Wells in these as well as many other fields have been equipped with Rector Heads

Well	*Field*	*Depth*
1 T. O'Connor 1	Greta	4392
1 Hirsch 2	Tom Ball	5583
2 Stafford 4	Iowa, Louisiana	6655
1 R. Driscoll Est. 1	Driscoll	3270
1 Davis-Holmes 1	Livingston	4347
1 Polk 2-B	Port Neches	5906
1 Cobb 2	Van Vleck	7076
2 Kratzer 1	Roanoke, La.	8830
3 State-Foster 2	Uunice, N. M.	3906
4 McElroy 103	Crane Co. (drilling)	10900
4 Less K. Johnson 5	Foard Co.	3626
3 I. B. Ogg 1	Jal, N. M.	3525
3 No. 1-D State	Hobbs, N. M.	4260
4 B. S. Walker 1	Andrews Co. (drilling)	4165
1 Simms-Smith 80	Goose Creek	6703
4 No. 15-C University	Big Lake	8609
4 White-Baker No. 1	Pecos Co.	9811

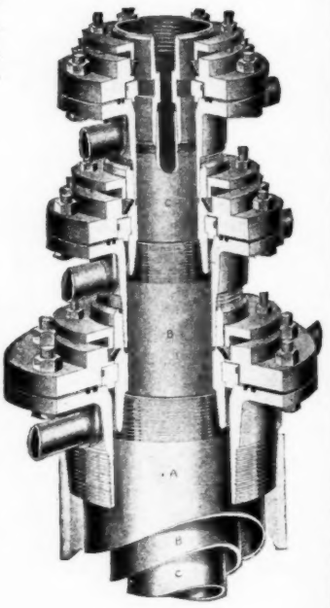
RECTOR WELL EQUIPMENT CO. Inc.

FORT WORTH, TEXAS

Branches: HOUSTON, MIDLAND *and* OKLAHOMA CITY

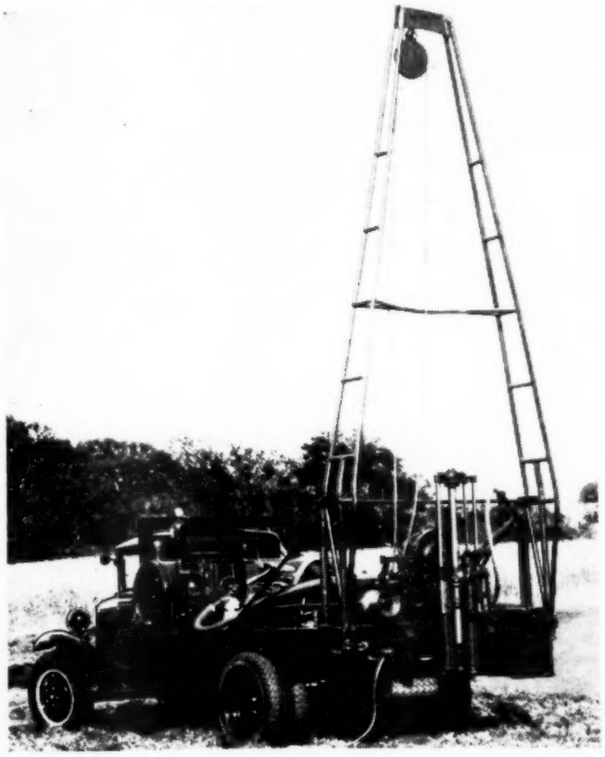
Export Representative

L. C. KLEIN, 285 Madison Ave., NEW YORK, N. Y.



3-section, 4-string hook-up. Each section is full 2-string hook-up and may be used independently. Above sections are shown with standard gland.

Core Drill Completes 35 Oil Structure Holes In Three Months



Here portable core drill mounted on truck is shown in drilling position in the field

AN interesting record of combined fishtailing and coring in structure holes with the Sullivan Type 21 Core Drill has just been reported from the Kansas fields by the geologist of a major oil company. The drill is mounted on a model "AA" Ford truck and the outfit has a mast high enough to take out 20 ft. of rods at a time. When on the move the mast lies down just above the truck cab.

The drill was equipped for removing 1⅛-in. cores and is capable of drilling to a depth of 1000 ft. successfully in most areas. In the area in question there are from 200 to 300 ft. of gravel and quartz boulders through which a string of casing must be set before any other work can be done. The outfit worked three men on each tour—driller, driller's helper, and water hauler.

In the three months' period covered by the record, drilling was conducted for 69½ days and 35 holes were completed. The total footage made was 28,236 ft., the average depth of the hole being 806.7 feet. Of this total footage, 27,464 ft. was fishtailed and 772 ft. cored. There was 7425 ft. of casing landed and 7226 ft. pulled.

This record shows that the Sullivan Type 21 Drill is particularly suited for shallow oil structure drilling. The truck-mounted machine is operated by the truck engine, using a standard make of power take-off. The circulating pump, also mounted on the truck with the drill, is operated through a clutch from a separate power take-off.

Bureau of Mines Improves Apparatus and Method for Determining Helium in Natural Gas

An improved apparatus and method for rapid and accurate determination of the helium content of natural gas and gaseous mixtures derived from that source have been developed in the Cryogenic Laboratory of the United States Bureau of Mines, Department of the Interior. A complete description of the apparatus and procedure for analysis has been made generally available to the public in a recently issued report of the Bureau under authorship of C. C. Anderson, associate chemist, U. S. Bureau of Mines Cryogenic Laboratory, Amarillo, Texas.

These improvements are the result of technical investigations that are a part of the Bureau's helium program, directed toward reducing costs of supplying all of this non-combustible gas used in the lighter-than-air-craft of the Army and Navy and toward assuring adequate supplies of this phenomenal war mineral.

The quantitative determination of helium in a gaseous mixture is accomplished by the removal of the other constituents from the sample, either by chemical or physical means, leaving only the helium which can be measured directly. Chemical methods, when applied to natural gas, require the burning of the hydrocarbons in oxygen, the absorption of the resulting carbon dioxide in a caustic solution, the removal of the excess oxygen in a suitable solution such as an alkaline pyrogallate, and the elimination of nitrogen by sparking or by combination with hot calcium or magnesium. Such procedures are very slow and tedious compared with the physical method that employs selective absorption by activated charcoal to separate the other constituents from the helium.

When cooled to liquid-air temperatures, activated coconut charcoal absorbs large volumes of the principal constituents of natural gas, such as nitrogen, methane, other gases of the hydrocarbon series, carbon dioxide, and oxygen, if the latter is present in the sample but does not absorb detectable quantities of helium, under the conditions prevailing in the analytical apparatus. The thousands of analyses made in the Cryogenic Laboratory indicate that in natural gases of this country hydrogen and neon are either absent or occur in such small percentages as to be absorbed readily by the quantity of charcoal usually employed.

Probable Development of Shale Oil Fields at Newnes, New South Wales

The Prime Minister of Australia has announced that, after examination of the report of the Newnes Investigation Committee on production of oil from shale, the governments of the Commonwealth and New South Wales has decided that negotiations should be entered into with organizations qualified to develop the shale oil fields in New South Wales on the lines recommended by the committee. He said that the name of Imperial Chemicals Industries, Ltd., has been mentioned as a desirable company to undertake the work.

The Prime Minister stated that the Federal Government was prepared, in co-operation with the government of New South Wales, to give financial and other assistance which might be necessary to develop the field. Any company formed to operate at Newnes, New South Wales, would be required to investigate and report to the governments on the possibilities of developing the industry in other areas.

Petroleum Production Technology

from exploration to the finishing of wells

THIS IS A REVIEW and reference work of fundamentals, problems, methods and equipment—for all interested in a broad, practical understanding of petroleum production—covering those practices connected with the construction of wells, ready to produce oil.

New Second Edition

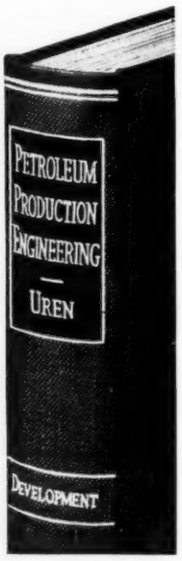
Petroleum Production Engineering

OIL FIELD DEVELOPMENT

By LESTER C. UREN

Professor of Petroleum Engineering, University of California

531 Pages, 6x9 • 258 Illustrations • $5.00



This is the first book of a two-volume edition, revised and enlarged to cover the far-reaching advances of recent years in this field. This book, complete in itself, gives a practical treatment of every phase of petroleum production engineering up to the point at which the wells are ready to produce. It introduces the fundamentals of field location and covers thoroughly the problems, methods and equipment of oil field development and modern deep-well drilling. ● Every process and method of any consequence is fully explained and complete descriptions are given with illustrations of all commonly used oil field equipment, tools and appliances. In assembling this book an effort has been made to develop a well-balanced treatment that does not unduly stress some topics nor slight others.

Chapter Headings

1. *Properties, Occurrence and Associations of Petroleum.*
2. *Petroleum Exploration Methods.*
3. *Acquisition of Title to Oil Lands.*
4. *Developing the Field.*
5. *Drilling Equipment and Methods; General Features.*
6. *Churn Drilling Equipment and Methods.*
7. *Rotary Drilling Equipment and Methods.*
8. *Casing, Casing Appliances and Casing Methods.*
9. *Fishing Tools and Methods.*
10. *Oil-field Hydrology; Exclusion of Water from Wells.*
11. *Finishing the Well.*
12. *Well Records.*

Order from

THE PETROLEUM ENGINEER PUBLISHING COMPANY

Tower Petroleum Building DALLAS, TEXAS

Enter my subscription to The Petroleum Engineer for ☐ 1 Year -- $1.00 ☐ 3 Years -- $2.00

Subscribe to The Petroleum Engineer

Name_____

Address_____

City, State_____

Information for ALL Operating Men . . .

While *The Petroleum Engineer* has a strong appeal to the highly trained engineer, it is in no wise a strictly technical publication. As a matter of fact, its editors strike a happy balance between technical and practical information. Operating men from men in the field to highest officials will find *The Petroleum Engineer* exactly suited to their needs and the publication is available at a moderate cost.

THE *Petroleum* **Engineer**

Dallas, Texas

New Process for Producing Motor Fuel Installed by Cokery in Germany

One of the cokeries belonging to the Niederschlesische Bergbau A.G., (Lower Silesia Mining Company) of Waldenburg, German Silesia, has completed arrangements for installing a new process for producing motor fuel that may have important consequences in the consummation of Germany's efforts toward increased independence of foreign petroleum sources.

The new process is designed, without increasing cokery production, to increase appreciably not only the yield of benzol and tar but also a type of tar oil that either can be used directly as motor fuel in the form of Diesel oil or by a further operation be converted into gasoline.

The Silesian cokery's adoption of the new process, based upon the recovery of oil from tar, marks a further step in the national program actively fostered by the Reich Government for increasing Germany's independence in the all-important sphere of motor fuel supply.

The Ruhr cokeries also have been active in increasing their yield of benzol, an important motor fuel competitive with gasoline in Germany, through the installation of improved equipment enabling a markedly increased benzol recovery.

Publish Volume on Petroleum Geology

"Problems in Petroleum Geology," a 1073-page book presenting carefully chosen data and coordinated theories of the origin of oil, has been published by the American Association of Petroleum Geologists. It constitutes a compilation of 43 previously unpublished technical papers by 47 different authors, and is edited by W. E. Wrather and F. H. Lahee.

The volume represents a summation of present knowledge, based on the best available evidence, and contains treatises never before published. Some of the papers, however, have been read in preliminary form before meetings of the association and other organizations, including the American Petroleum Institute.

The book, known as the "Sydney Powers Memorial Volume," has nearly 200 illustrations, as well as maps, charts, complete bibliographies, and a 50-page index. It is available in this country from the Association at P. O. Box 1852, Tulsa, Okla., and abroad from Thomas Murby & Co., 1 Fleet Lane, London, E. C. 4. The price is $6.

For convenience, the book is divided into seven parts: History, Origin and Evolution of Petroleum; Migration and Accumulation of Petroleum; Relations of Petroleum Accumulation to Structures; Porosity, Permeability, Compaction; Oil Field Waters; and Sub-Surface Temperature Gradients.

Jarecki Store for Jal, N. M.

The Jarecki Manufacturing Company has opened a new field store at Jal, in Lee County, New Mexico. Matt Blair is the store manager, and Ernest Reynolds field salesman.

Constructing Two Cracking Units in French Refinery

Two Dubbs cracking units are under construction at the Petit-Couronne refinery of La Societe Anonyme des Petroles Jupiter, near Rouen, France. One unit is to crack heavy oil and the other is for reforming. The former will have a charging capacity of about 4200 bbl. per day and will operate on the selective two-coil cracking principle.

The reforming unit will have a charging capacity of about 2380 bbl. per day and will be used to improve the octane number of the straight-run gasoline.

The charging stock for both units will be Iraq crude, delivered through the newly finished pipe line.

The two cracking units are expected to be put in service early next spring.

Motion Picture on Oxy-Acetylene Welding and Cutting Process

"The Prosperity Process," a new two-reel motion picture, has been produced by the International Acetylene Association, 30 East 42nd. Street, New York, N. Y., showing the application of the oxy-acetylene process of welding and cutting metals to a wide range of industrial problems in the repair, reclamation and production of metal parts.

The picture is suitable for technical society meetings, engineering colleges, technical, high and trade schools, student sections of the engineering societies, superintendents' meetings, safety meetings, foremen's club meetings, and other similar gatherings. It requires approximately 25 minutes to show.

The film is available in 16 mm. size, which can be shown on standard portable 16 mm. motion picture projectors. Arrangements to borrow this film can be made through the office of the secretary of the association. Organizations desiring the use of this picture should specify the date most convenient for its showing, together with an alternate date.

Petroleum Division of Special Libraries Association

At a meeting of Special Libraries Association a Petroleum Section was formed within their Science-Technology group. The intention of this section is: To bring in closer contact all libraries whose work deals with petroleum and its allied subjects; to make a decimal classification of petroleum subjects; to facilitate inter-library loans; and to exchange duplicate material. Any librarian interested is requested to write Albert Althoff, Librarian, General Petroleum Corporation of California, 2525 East 37th Street, Los Angeles, California.

Westinghouse Appoints Hart Welding Supply Company

The Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has appointed the Hart Welding Supply Company of Oklahoma City, Oklahoma, as its official welding dealer for the entire state of Oklahoma and the Panhandle of Texas.

Made District Sales Manager

O. E. BERG has been appointed district sales manager in the southwest territory for the Allegheny Steel Company of Brackenridge, Pennsylvania. He will be located at 4511 Stanford Street, Houston, Texas. Berg received metallurgical training at Columbia University, New York City, and at one time was associated with the A. O. Smith Company.

Norma-Hoffmann Appoints Southern Representative

The Norma-Hoffmann Bearings Corporation, Stamford, Conn., manufacturers of precision ball and roller bearings, announces the appointment of E. W. Lawrence as its southern representative. He has for the past 11 years been connected with the New York sales office.

Private Companies Forbidden to Drill in Argentina's National Territories

The executive power of Argentina, South America, has issued a decree to the effect that private oil companies can no longer drill in the national territories and that such drillings may be done only by the Yacimientos Petroliferos Fiscales. This decree will operate until action is taken by the National Congress on the proposed petroleum law.

Produced in the world's largest sucker rod plant

THE S. M. JONES CO.
TOLEDO, O.

ELMER F. SCHMIDT
Co-Author of This Article

The Internal Corrosion of Natural Gas Lines[a]

By
ELMER F. SCHMIDT*
and
THOMAS S. BACON†

THE transportation of fuel gas has created many problems since the installation of the first gas line but no other problem has presented more difficulties than the corrosion of pipe. Despite the investigations aimed at its elimination, corrosion continues to exact its heavy toll at the expense of the gas industry, but as our knowledge of its causes and of the means for its prevention increases it is probable that there will be a corresponding reduction of the damage arising from this cause.

Due to the fact that external corrosion is normally more rapid and always more readily determinable than the processes of internal corrosion, it is natural and proper that the major efforts of the industry have been directed to the prevention of the more general and more active cause of destruction. As a result of these efforts substantial progress has been made in this direction and it is probable that the question of the mitigation or elimination of the more localized problem of internal corrosion will receive increasing attention. The Pacific Coast Gas Association has formed a committee to study the problems arising from the internal corrosion of natural gas lines.[1] It is certain that other companies are giving the subject some study, as evidenced by the fact that Lone Star Gas Company has been actively concerned about the internal corrosion of some of its lines since 1925. It is the purpose of this discussion to summarize the causes and effects of internal corrosion in natural gas transmission lines.

The effects of internal corrosion are varied. If the corrosion causes severe pitting, leaks will develop in the line, causing loss of gas and the expense of applying leak clamps. If the corrosion removes a channel of metal from the bottom of the pipe, "blow-outs" will occur, accompanied by obvious hazards to life and property. If the internal pipe surface is roughened by corrosion, line capacity will be materially reduced. A recent article has indicated a very definite increase of the friction factor of a natural gas transmission line that occurred as corrosion proceeded.[2] Also, the products of corrosion occupy more volume than the uncorroded iron and may reduce the effective cross-sectional area of the pipe, thereby reducing the capacity of the line.

We are first interested in the conditions that must be present to cause internal corrosion. Most natural gas transmission lines, even after many years of service, show no evidence of internal corrosion. Occasional lines have required replacement after five or six, or even fewer, years of service because of internal corrosion, due to peculiar local conditions. Natural gas itself has no corrosive action on pipe lines, but certain constituents or combination of constituents that the gas may contain will corrode pipe lines under favorable conditions.

The electrochemical theory of corrosion requires that liquid water be present on the pipe surface and that oxygen be present in the gas passing through the pipe, before serious corrosion can occur. According to this theory, the atoms of iron on the pipe surface replace some of the hydrogen ions present in the water. The hydrogen ions replaced form hydrogen gas on the pipe surface. For corrosion to proceed, this hydrogen gas must be removed. Removal of this hydrogen gas in the form of gas bubbles is ordinarily slow, unless the corrosive solution is highly acid. In normal pipe line corrosion the film of gaseous hydrogen is removed by its reaction with oxygen to form water. The oxygen required for this reaction is absorbed from the gas. While largely determined by the rate at which the hydrogen is removed from the pipe surface, the rate of corrosion may be accelerated by the presence of high concentrations of hydrogen ions in the corrosive solution, caused by the presence of acid in the solution, or by the presence of ionized salts in the solution.[3]

Liquid water must be present in the pipe line for corrosion to occur, unless the pipe line is operating at temperatures that are very much in excess of normal operating temperatures. Corrosion of iron by hydrogen sulphide in the absence of liquid water is not appreciable until the iron reaches a temperature above 400 deg. fahrenheit.[4, 5, 6] At temperatures within the range of pipe line operation, compounds that are normally corrosive when associated with liquid water become non-corrosive when absolutely dry. For example, concentrated sulphuric acid, free from water, may be shipped in ordinary steel tank cars. Also, pure, dry hydrogen sulphide gas may be stored and shipped under pressure in ordinary steel cylinders. However, it is somewhat confusing to find that iron oxide boxes used for the removal of hydrogen sulphide from fuel gas have been found to operate most efficiently when the inlet gas has relative humidity of somewhat less than 100 and as low as 50. Under these conditions of humidity it is to be expected that no liquid water would be present on the surface of the iron oxide. The iron oxide box is essentially a place provided in the gas distribution system for corrosion to occur so that the raw gas will exert all its corrosive action on the iron oxide and will not corrode the distribution lines. It is quite possible that the surface of the iron oxide used in the boxes is actually covered with liquid water, even though the gas passing over the oxide is not saturated with water vapor. This may be explained by assuming absorption of water vapor in the colloidal pores of the oxide to form liquid water in these pores. It is conceivable that similar phenomena could also occur in natural gas lines. Assume, for example, that a particular line has been carrying natural gas containing some hydrogen sulphide, free oxygen, and sufficient water vapor to cause condensation in the line. Such a condition is conducive to corrosion. It is possible that this corrosion may cause the formation of capillaries in the pipe metal so that even if the gas entering the line were dehydrated sufficiently to prevent condensation in non-capillary iron pipe, condensation in the capillaries and consequently corrosion of the particular line might continue even after dehydration. This is a theory that has not been demonstrated, but the possibility of condensation in capillaries should be borne in mind when considering the effects of dehydration. So the statement may be repeated

---

a—Presented before the American Gas Association at Atlantic City, New Jersey, October 29, 1934.

*General Superintendent, Lone Star Gas Company, Dallas, Texas.
†Research Engineer, Lone Star Gas Company, Dallas, Texas.

that internal corrosion cannot occur unless liquid water is present on the pipe surface, with the addendum that due to physical nature of the pipe surface liquid water may be present, even though the gas is not saturated.

Even if all other factors favorable for corrosion are present, such as high pressure, high hydrogen sulphide concentration, and liquid water on the pipe surface, experience has clearly indicated that serious corrosion will not occur unless oxygen is also present. For example, a large natural gas transmission line is taking gas from high pressure wells in New Mexico. The hydrogen sulphide content of the raw gas is in excess of 200 grains per 100 cu. ft. and is reduced to about ten grains per 100 cu. ft. by scrubbing with a soda ash solution. This scrubbing saturates the gas with water vapor at line pressure and at a temperature normally in excess of line temperature, and consequently causes condensation to occur in the line. But the gas contains no free oxygen and internal corrosion is reported to have been negligible after six years of operation. In this connection, Speller showed appreciable corrosion rates for steel when treated with wet hydrogen sulphide in the absence of air or oxygen.[7] On the other hand, the P.C.G.A. committee has concluded that corrosion by hydrogen sulphide will be very much reduced if the oxygen concentration of the gas is reduced, or eliminated.[1]

The presence or absence of free oxygen in gas may be shown by bubbling the gas for an extended period of time through an alkaline pyrogallol solution. The solution should be prepared in an atmosphere free of oxygen, so that it may be as colorless as possible. If the gas contains free oxygen, the solution will darken as the gas bubbles through it.

Where natural gas is free of oxygen but contains appreciable concentrations of hydrogen sulphide (more than two grains of hydrogen sulphide per 100 cu. ft.) trouble may be experienced with corrosion of copper and brass fittings on domestic appliances, even though no trouble is experienced in the iron distribution lines. This is particularly noticeable in brass or copper pilots as used on domestic appliances. Hydrogen sulphide has a decided affinity for copper at elevated temperatures. In fact, at temperatures above 240 deg. fahr. a polished strip of copper will be instantly discolored by natural gas containing four to five grains of hydrogen sulphide per 100 cu. feet. The product of the reaction is a black or brown copper sulphide powder resembling an accumulation of pipe line dust. The dust has been found to form rapidly enough to stop up water heater pilots in a period of a few weeks when using natural gas containing about five grains of hydrogen sulphide per 100 cu. feet. This trouble has been experienced by the Texas Cities Gas Company in El Paso, Texas, and by the Southern Counties Gas Company in Los Angeles.[8] Similar conditions in Salt Lake City, Utah, have also been reported. This specific case of corrosion is very different from the corrosion of transmission lines inasmuch as oxygen and liquid water are both absent.

The exact rôle of oxygen in accelerating hydrogen sulphide corrosion of pipe lines is not definitely known. It is possible that oxygen, in addition to affecting depolarization, also changes the nature of the scale formed. In the absence of oxygen a dense, black, adherent scale is found inside the pipe, composed largely of iron sulphide, that protects the uncorroded metal from the further action of hydrogen sulphide. In the presence of oxygen the scale is not uniformly black, but is a brown-black scale, either flaky or as nodules, and is more porous and less adherent, offering less protection to the underlying layer of uncorroded metal. The color of the scale appears to become more black and less brown as the partial pressure of free oxygen in the gas decreases.

Hydrogen sulphide and carbon dioxide are the acid constituents most commonly found in natural gas. Carbonic acid is an extremely weak acid, and probably has but little effect on pipe corrosion.[10, 11, 33]

Hydrogen sulphide is also a very weak acid. However, in the presence of liquid water and oxygen it will react readily with iron or iron oxides. Most of the internal corrosion of natural gas transmission lines has been shown to occur in the presence of hydrogen sulphide, free oxygen, liquid water, and high pressure.[1, 13] Serious corrosion may occur when one or all of these factors are present in extremely slight concentrations. Corrosion of copper has been reported when exposed to gas containing less than 0.01 grains of hydrogen sulphide per 100 cu. ft., and less than 0.1 per cent oxygen, with a gas pressure of from 375 to 400 lb. per sq. in. gauge.[1]

Devine, Wilhelm and Schmidt have attempted to correlate the quantitative effects of these various factors on corrosion rates of pipe steel.[13] They found the rate of corrosion to increase directly as the absolute pressure with other factors held constant. Corrosion also increased directly as the hydrogen sulphide content of the gas. These authors found the oxygen/hydrogen sulphide ratio to be more useful in considering the effect of oxygen on corrosion rate, than the absolute concentration of oxygen.[14] The corrosion rate was found to increase with increase in the oxygen/hydrogen sulphide ratio, until the volume of oxygen present was 114 times the volume of hydrogen sulphide present. Any further increase in the oxygen content appeared to be without much effect on the corrosion rate. It might be pointed out that this ratio of 114 volumes of oxygen per one volume of hydrogen sulphide will be obtained with a very low concentration of oxygen present when the concentration of hydrogen sulphide is also low. For example, a gas containing 0.10 grains hydrogen sulphide per 100 cu. ft. would require $\frac{0.10}{630} \times 114 = 0.0181$ per cent by volume of oxygen for the desired oxygen/hydrogen sulphide ratio. This small concentration of oxygen would be impossible of detection by ordinary analytical methods.

The above authors report the effect of amount of liquid water present is more obscure, but probably maximum rates occur with minimum thickness of water film on metal surfaces. However, several observations of pipe lines that have been corroded by hydrogen sulphide under these conditions show maximum corrosion in the bottom of the pipe where water has been flowing or standing and the liquid film is of maximum thickness.[1, 2] Possibly, the physical motion of the water has some effect on these cases.

The corrosion rate in steel pipe may be assumed to be roughly proportional to the partial pressure of hydrogen sulphide in the gas, so long as liquid water is present and the concentration of oxygen is more than 100 times the concentration of hydrogen sulphide. The available data are insufficient to permit any accurate estimation of the rate of corrosion that will occur with a given partial pressure of hydrogen sulphide in the gas. The data presented by Devine, Wilhelm and Schmidt[13] have been compared with the observed results of corrosion of a natural gas transmission line operating under pressures of from 200 to 400 lb. per sq. inch. The gas entering the line contained about 1.5 per cent of oxygen by volume, and about 1.3 grains of hydrogen sulphide per 100 cu. feet. Moisture has been present in the line at all times. The above authors indicate a pipe line life of about five years under these conditions. The actual life of the first 1.5 miles of line was about eight years. However, several individual joints of pipe in this line required replacement after about four years of service.

The probable effects of high pressure on normal pipe line corrosion may be clarified by considering the film of liquid moisture that is present on the pipe surface. New clean steel pipe completely covered with a film of water when placed in service is subject to the corrosive action of the water

The *ORIGINAL* "Overhead-Packing" Casing Head

HERCULES pioneered the casing head with packing *above* the slips, commonly known as "overhead packing." This type casing head is now in demand by operators everywhere.

All parts for the HERCULES Casing Head can be installed without stripping. Again, a HERCULES Head is a full-opening head without shoulders or obstructions. Thus collars will not hang, or cause sparks resulting in serious accidents or fires.

HERCULES Heads are simple to install, with fewer parts, yet are complete and meet every requirement.

See your supply store, or phone or write

HERCULES TOOL COMPANY

MANUFACTURERS OF OIL WELL SPECIALTIES

Offices: Kennedy Building, Tulsa, Oklahoma
Phone 3-2358
Cable Address: HERTOCO

FORT WORTH
Fair Bldg., Box 954
Phone 2-7028

Export Office:
Rooms 601-2
285 Madison Avenue
NEW YORK

film on its surface and is not subject to the corrosive action of the gas that may be inside the pipe, except as the gas modifies the nature of the water in the film. At equilibrium, the partial pressure of any constituent of the gas dissolved in the water must be equal to the partial pressure of the same constituent in the gas. Hence, under this hypothesis, gas containing ten grains of hydrogen sulphide per 100 cu. ft. and transmitted at atmospheric pressure should produce the same concentration of hydrogen sulphide in the liquid film as gas containing one grain of hydrogen sulphide per 100 cu. ft. under an absolute pressure of ten atmospheres, and the corrosion rates of the pipe in the two cases should be equal. The concept of film resistances can probably be applied advantageously in further studies of pipe line corrosion.

Although most of the serious cases of internal corrosion of pipe lines that have been reported have been caused by hydrogen sulphide, other corrosive agents may cause trouble in some localized cases. For example, in one specific case, iron chloride was present in drip liquor from the line. The wells in this district were being treated with hydrochloric acid at the time, so this treatment was suspected of causing the trouble. Further investigation showed that the treatment of the wells was not responsible, but that water used in a gas cleaner was the source of the chlorides. The gas carried some entrained water out of the cleaner, and the water supplied to the cleaner contained large concentrations of chlorides. In this way the chlorides entered the line.

In order to stabilize the calorific value of gas for distribution where the raw gas varies through a wide range of heat value, some gas companies add inert gas largely composed of nitrogen and carbon dioxide. If the inert gas is prepared by burning natural gas in air, serious line corrosion will occur, due to the formation of oxides of nitrogen in the gas during combustion. These oxides of nitrogen are formed in all normal natural gas flames, but in normal practice they have no corrosive action. However, if the products of combustion are compressed to pressures considerably above atmospheric pressure and then cooled to atmospheric temperature, the corrosive action of the oxides of nitrogen becomes very evident due to the formation of nitric acid under these conditions.

Natural gas containing low concentrations of oxygen and appreciable concentrations of heavier hydrocarbons compressed through several compressions in a single-stage compressor, may form organic acids (formic, acetic, etc.) that will cause serious corrosion. A very high compression ratio is required and such a high compression ratio is not good economy.

Corrosion of pipe lines may usually be detected by analyses of drip liquors obtained from the lines. As a rule, the corrosive constituents present in very small concentrations in the gas are present in the drip liquors in much greater concentrations and are therefore more easily determined. A rough idea of the minimum corrosion occurring in the line may be obtained from a knowledge of the volume of drip liquor obtained from the line per unit time and the concentration of iron in the drip liquor. However, in the case of hydrogen sulphide corrosion, only about 50 per cent or less of the corroded iron is usually removed from the line in the drip liquors. Drip liquors from lines containing low concentrations of hydrogen sulphide and an appreciable concentration of oxygen will contain most of the sulphur combined as sulphate rather than as sulphide.

Analysis of the discharge gas for dust may also indicate the presence of internal corrosion, though this method is far less reliable than the drip liquor analysis. When dust-free gas enters the line, and gas laden with iron-bearing dust leaves the line, it is very probable that internal corrosion is occurring.

As a rule, dust caused by corrosion has been found to consist predominantly of various oxides of iron, with only small concentrations of the corroding agent present.[11] This has led to the development of a theory regarding the repeated attack of the pipe by the corrosive agent in the gas. For example, the corrosive agent reacts with metal in the up-stream end of the pipe to form a soluble iron compound. Oxidation and/or hydrolysis of this compound then occurs, precipitating iron hydroxide and freeing the corrosive agent so that it may attack more metal.

The actual mechanism of corrosion is of interest and should be studied as completely as possible. Theories to account for the mechanism of various types of corrosion have been proposed by various investigators. Some of these theories are very interesting, but as none of them seems to have any direct practical application in their present form, they will not be further discussed here.

Prevention of Corrosion by Hydrogen Sulphide

Internal corrosion of gas transmission and distribution lines by hydrogen sulphide may be eliminated or alleviated in the following ways:

1. Protection of the pipe metal by applied coatings.
2. Use of pipe metal alloys that will withstand corrosion.
3. Dehydration of the gas entering the distribution system.
4. Removal of oxygen from the gas.
5. Removal of hydrogen sulphide from the gas.
6. Addition of inhibitors to the gas.

The use of protective coatings inside the pipe is receiving an increasing amount of attention. An optical device has been developed to permit complete inspection of the coating after application in small-sized pipe. Cement-lined pipe has been used with some success in handling corrosive gases and liquids.[4, 15, 31]

A wide variety of protective films, such as lacquers, tars, greases, anti-oxidants, etc., are on the market, but have not been generally accepted for use by the gas industry.[16, 17] One gas company on the west coast has applied an oil film to the inside of a transmission line operating under corrosive conditions by injecting a light oil into the compressor station discharge gases. It has been reported that in this instance the rate of corrosion of the line was reduced at least 75 per cent.[32] Glass-lined and rubber-lined pipe at present are too expensive to warrant their general use. Several of the new synthetic lacquers appear to have distinct possibilities for use as protective coatings inside line pipe.

At present the use of corrosion-resisting alloys for pipe fabrication seems to be limited to the development of a reasonable priced pipe lined with a thin layer of a high-chrome stainless alloy.[1] None of the less expensive alloys has sufficient resistance to hydrogen sulphide corrosion to warrant their use.[18]

The possibilities of dehydration of gas entering the transmission system have received considerable attention. Several commercial installations have been made, with apparently good success.[1, 19, 20, 21, 22, 23, 24, 25]

In many cases, dehydration of the gas appears to offer the best solution to the problem of internal corrosion.[26] Dehydration may be applied most advantageously in the case of high-pressure transmission systems, as the gas entering such systems contains relatively little water per 1000 cu. ft., and the load on the dehydrating system is much less than in the case of low-pressure gas.[27] The principal operating troubles with dehydrating systems using refrigeration appear to be the complete removal of the condensed water droplets from the gas, and trouble from freeze-ups. Natural gas hydrocarbons will react with water to form solid hydrates that have much higher "melting points" than that of water ice.[28] Dehydration of the gas has the advantage of preventing corrosion due to oxygen as well as that due to hydrogen sul-

for high pressure oil and gas lines

Two thousand pounds pressure to the square inch can be controlled, and gas can be passed on to the main or the distributing line at reduced pressure to suit requirements, by the use of the proper C-F Regulators. Standard Regulators are designed for pressure up to 600 pounds. For higher pressure, designs are adapted according to specification.

CF

The Chaplin-Fulton Mfg. Co.
28-40 Penn Ave., Pittsburgh, Pa.

Look for the *Arm-and-Hammer*

ARMSTRONG BROS.
CHAIN TONGS

All Standard and Reversible Jaw Types.
All Sizes.

To each flat link chain is attached the Arm-and-Hammer seal—evidence that chains have been proof tested to two-thirds Catalog Strength.

Every Chain Proof Tested to Within 1/8 of Specified Strength. (1200 to 40000 lbs.)

These are superior tongs with improved designs that give jaws far greater bearing on the bar. *Jaws* drop forged from special steel are heat treated, hardened and tested for wearing qualities. *Handles* forged from special high carbon steel have both stiffness and "spring." Bolts are large, are hardened; shackles forged alloy steel. In every detail stronger, more dependable tools.

Write for Catalog

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
331 N. Francisco Ave., CHICAGO, U.S.A.
Factory Representative: EARL WADDELL
1524 Fair Building, Fort Worth, Texas

AMERICAN
STEEL
SHEETS
FOR ALL KNOWN USES

KEYSTONE COPPER STEEL
AMERICAN
SHEET AND TIN PLATE COMPANY
PITTSBURGH

In the Petroleum Field

For tanks, drums, roofing and siding of shops, sheds, boiler and belt houses, and general sheet metal work, Keystone Copper Steel *gives maximum rust resistance.*

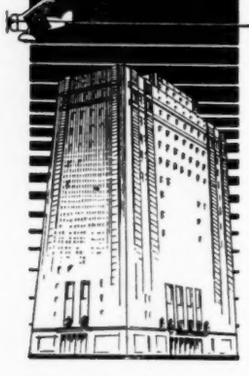
Insist upon AMERICAN Black Sheets, Keystone Rust Resisting Copper Steel Sheets, Apollo Best Bloom Galvanized Sheets, Galvannealed Sheets, Heavy-Coated Galvanized Sheets, Formed Roofing and Siding Products, Tin Plates, Terne Plates, Black Plate, Etc.

Write us relative to your sheet steel requirements. This Company also manufactures USS STAINLESS and Heat Resisting Steel Sheets and Light Plates for all purposes.

AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.

SUBSIDIARY of UNITED STATES STEEL CORPORATION

GOING TO TULSA



Then select the hotel that is the choice of more prominent people in all walks of life.

COMFORT PRESTIGE
EXCELLENT FOOD

All rooms with bath. Rates from $2.00

S. J. STEWART, MANAGER

ALVIN HOTEL

TULSA, AAA OKLAHOMA

phide, and also prevents the accumulation of liquid water in the line, eliminating drip blowing and reducing freeze-ups of the line.

Some investigators[1] suggest that operating practice be improved to such a point that free oxygen in the gas is substantially eliminated. This may be possible in some systems, but is obviously impossible with other systems. For example, a large gas company is handling residue gas from several gasoline absorption plants at one of its compressor stations. The gas contains about 1.5 grains of hydrogen sulphide per 100 cu. ft., and about 1.5 per cent free oxygen. Many of the wells in this district are produced under a vacuum of more than ten inches of mercury and the producing companies find trouble in keeping the oxygen content less than 1.5 per cent. It has previously been shown that only 0.3 per cent of oxygen would be required in this gas for the maximum rate of corrosion to occur and it is probable that even 0.1 per cent of oxygen would still cause serious corrosion.[13] Such a reduction in the amount of oxygen that leaks into the system could not be accomplished with any practical system of gathering lines.

An economical method for the substantially complete removal of oxygen from natural gas would be welcomed by the industry. Such a method can possibly be developed.

Processes for the removal of hydrogen sulphide from gas have been the subjects of many investigations. Nearly all the "liquid" processes, such as the soda ash process developed by the Koppers Company, will leave appreciable amounts of hydrogen sulphide in the scrubbed gas and are relatively expensive when applied to the treatment of high-pressure gas containing concentrations of hydrogen sulphide of less than five grains per 100 cu. feet. The iron oxide box will remove hydrogen sulphide almost quantitatively if properly used. The high cost of construction and operation of such boxes under high pressures prevents their use on most natural gas lines.

The Lone Star Gas Company has developed a liquid scrubbing process for the removal of hydrogen sulphide from high-pressure natural gas containing oxygen that appears to be capable of effecting nearly as complete removal of hydrogen sulphide as the iron oxide box at a much lower operating cost. This process has been in operation on a line carrying 10,000,000 cu. ft. of gas per day for two years, and has effected a very considerable reduction in the rate of corrosion of the pipe line. The gas is passed through a suspension of iron and zinc salts in a dilute soda ash solution. The oxygen in the gas is partly absorbed by the alkaline solution and serves to oxidize the metallic sulphides formed in the solution nearly as rapidly as they are formed. Due to this rapid oxidation the partial pressure of hydrogen sulphide over the scrubbing solution is maintained at a very low value and consequently the partial pressure of hydrogen sulphide in the scrubbed gas is maintained at a low value so long as good contact is obtained between the gas and the scrubbing solution. Cost of operation of this installation is about 0.18 cents per 1000 cu. ft., largely due to the high depreciation rate of the scrubber caused by rapid corrosion. This depreciation cost may be decreased by the use of a stainless steel scrubber. Considerable quantities of free sulphur are formed in the process and means for the removal of this sulphur from the scrubber are provided.

The addition of some chemical to the gas to inhibit the action of corrosive agents in the gas is a method of attack that has received no attention by the gas industry to date. The use of inhibitors has been very successful in the hydrochloric acid treatment of oil wells and in the refrigeration industry.[29] A successful inhibitor for preventing the corrosion of iron, copper, and brass by mercaptans has been developed. Recent experimental work that has been done on the development of an organic inhibitor to be used to pre-

vent corrosion by brine is of interest in this connection.[30]

The above discussion has been concerned only with the physical and chemical causes, effects, and remedies of corrosion. Before the above information can be applied to any operating problem, it must be reduced to terms of dollars and cents. Unless the saving obtained from prevention of corrosion is greater than the cost of preventing the corrosion, it is preferable to allow the corrosion to continue. Therefore, each problem of corrosion must be considered individually, as the economic factors are different in each case. It will be evident from the previous discussion that the economic values involved in any consideration of internal corrosion of natural gas transmission lines are not well defined at present. This lack of definition is due almost entirely to a lack of knowledge of the physical and chemical factors that control corrosion and remedies for corrosion.

The concensus at present appears to be that the most economical way of preventing internal corrosion of many natural gas transmission lines is by dehydration of the gas entering the lines. This opinion seems to be warranted by the manifold advantages that are obtained by dehydration, and by the very low costs of dehydration that are made possible by good engineering. It might be pointed out in this connection that many long transmission lines serve to dehydrate the gas automatically. Temperature and pressure conditions are often such as to cause separation of liquid water in the first ten or twenty miles of line. After the gas has reached ground temperature, it will be cooled no further, but the pressure will continue to drop as the gas passes through the line, due to friction, and finally reaches an unsaturated condition. These considerations are applicable only to lines in which the gas flow is fairly uniform, and do not apply to lines that are subject to intermittent flow at the downstream end and "packing."

The problem presented by the internal corrosion of pipe lines is complex, but can be solved by the application of known principles of engineering, chemistry, and economics. It offers an excellent opportunity for coöperative research.

LITERATURE CITED

[1]P.C.G.A. Report, *Western Gas*, Sept. 1933, p. 45.
[2]F. Wills, *Western Gas*, Sept. 1934, p. 14.
[3]F. N. Speller, "Corrosion," McGraw Hill (1926), pp. 9 and 10.
[4]F. N. Speller, *Oil and Gas Journal*, Feb. 16, 1933, p. 74.
[5]Morrell & Egloff, *Industrial and Engineering Chemistry*, 24, p. 509 (1932).
[6]F. N. Speller, "Corrosion," p. 518.
[7]*Ibid.* p. 163.
[8]J. C. Gilbert, *Western Gas*, April, 1934, p. 16.
[9]R. F. Passano, *Industrial and Engineering Chemistry*, 25, pp. 1247-1250 (1933).
[10]Anon, *Gas Industry*, 21, No. 2, p. 49 (February, 1927).
[11]P.C.G.A., Committee on Dust and Moisture Control, 1927.
[12]Milbourne & Huff, *Industrial and Engineering Chemistry*, 22, No. 11, p. 1213 (1930).
[13]U. S. Bureau of Mines, Technical Paper 560.
[14]U. S. Bureau of Mines, Report of Investigation 3160.
[15]Baker, *The Petroleum Engineer*, May, 1933, p. 29.
[16]Pickett and Schantz, *Industrial and Engineering Chemistry*, 26, p. 708.
[17]Ellis, *Ibid*, 25, p. 125.
[18]A.I.M.M.E., Technical Paper 531.
[19]F. W. Sperr, Jr., *Chemical and Metallurgical Engineer*, 34, p. 97 (1927).
[20]Perry & Duus, *Ibid.*, 41, pp. 74-77 and 127-129 (1934).
[21]E. F. Coffman, *Gas Age-Record*, April 14, 1928, p. 507.
[22]W. T. Ziegenhain, *Oil and Gas Journal*, Sept. 24, 1931, p. 34.
[23]Harris, *Gas Age-Record*, Dec. 10, 1927, p. 877; Dec. 17, 1927, p. 919.
[24]Spindle, *Ibid.*, July 13, 1929, p. 39.
[25]Mezger-Pistor, *Gas Age-Record*, Aug. 30, 1930, p. 310.
[26]Report of Committee on Dehydration, A.G.A., 1930.
[27]C. H. M. Burnham, "Water Vapor in Natural Gas," *Western Gas*, June, 1932.
[28]Hammerschmidt, *Industrial and Engineering Chemistry*, 26, No. 8, p. 851 (1934).
[29]Putnam & Fry, *Ibid.*, 26, No. 9, p. 921 (1934).
[30]Ardagh, Roome & Owens, *Ibid.*, 26, No. 10, p. 1116 (1934).
[31]E. L. Chappell, *Ibid.*, 22, No. 11, p. 1203 (1930).
[32]Wm. Moeller, Jr., Private communication.
[33]Speller, "Corrosion," p. 160.

Gottkool
WATER CANS & COOLERS
The GOTT Water Can is the practical way to keep a fresh supply of drinking water cool and pure, always handy to the job wherever it may be—it's health insurance...Your supply store has them. Get one today!
H. P. GOTT MFG. CO., Winfield, Kansas
KEEP PURE DRINKING WATER ALWAYS HANDY

THE *Standard* WATER CAN OF THE PETROLEUM INDUSTRY

LUFKIN TAPES

"Atlas"
The World's Best Gauging Tape

"Challenge"
for Engineering, Strapping and General Measuring
Send for Catalog covering complete line

THE LUFKIN RULE CO. SAGINAW, MICH.
106 Lafayette St., New York City

XENOPHON D. IDES — Electrical Engineer
Specialist in Electrical Installations for the Petroleum Industry
Power and Industrial Applications
Automatic Process Controls and Special Problems
Design — Construction — Surveys — Reports
Drexel Bldg., Independence Square PHILADELPHIA, PA.

SPERRY-SUN WELL SURVEYING CO.
1608 WALNUT STREET, PHILADELPHIA, PA.
DALLAS, TYLER AND HOUSTON, TEXAS. TULSA, OKLAHOMA AND LOS ANGELES, CALIFORNIA
SURWEL (Gyroscopic) • SYFO (Ink Bottle)
UNDERGROUND WELL SURVEYING SERVICE

● HYDRAUGER ●
MODERN HORIZONTAL BORING MACHINE
For Underground Installation of Pipe and Conduits. Avoids damage to costly pavements and saves time. Send for Bulletin.
HYDRAUGER CORPORATION, Ltd.
343 Sansome St. San Francisco, Calif.

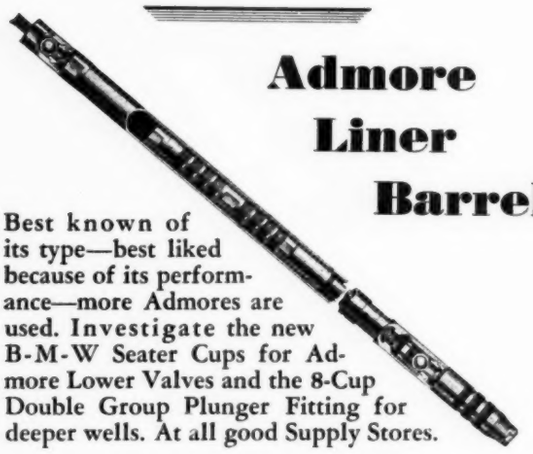
B PRODUCTS for pumping wells

The **KEY** to LOWER LIFTING COSTS

CORRECTLY DESIGNED · · ECONOMICALLY PRODUCED

REASONABLY PRICED

LOWER LIFTING COSTS are DIVIDENDS earned by these two B-M-W PRODUCTS

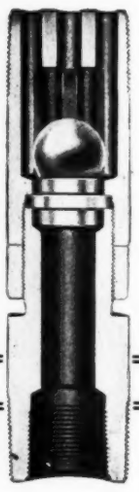


Admore Liner Barrels

Best known of its type—best liked because of its performance—more Admores are used. Investigate the new B-M-W Seater Cups for Admore Lower Valves and the 8-Cup Double Group Plunger Fitting for deeper wells. At all good Supply Stores.

B-M-W OVERSIZE LOWER VALVE

You will appreciate the Oversize if you have trouble with standard pattern leather packed Lower Valves. Threads directly into lower working barrel coupling, forming a fluid-tight joint. Does not sand up readily.



A B-M-W PRODUCT

BRADFORD MOTOR WORKS INC.

OIL WELL SUPPLIES

BRADFORD, PA. TULSA, OKLA.

EXPORT OFFICE – 30 CHURCH ST. – NEW YORK CITY

INDEX *to* ADVERTISERS

Allis-Chalmers Manufacturing Co.	161
Alvin Hotel	172
American Cable Co.	Inside Back Cover
American Hammered Piston Ring Co.	149
American Iron & Machine Works	5
American Lubricator Co.	D–7
American Meter Co.	6
American Sheet & Tin Plate Co.	172
American Steel & Wire Co.	74
Armstrong Bros. Tool Co.	171
Axelson Manufacturing Co., Ltd.	C–20
Baash-Ross Tool Company	C–50
Baker Oil Tools, Inc.	C–34
Baroid Sales Co.	C–42
Bartlett-Hayward Co.	67
Biltmore Hotel, Los Angeles	C–31
Bradford Motor Works	174
Broderick & Bascom Rope Co.	11
Buccaneer Hotel	159
Byron Jackson Co.	C–33
Cavins Company, The	C–47
Chaplin-Fulton Mfg. Co., The	171
Chapman Valve Manufacturing Co., The	137
Continental Supply Co., The	D–17
Cooper-Bessemer Corporation, The	15
D & B Pump & Supply Co.	C–37
Dresser, S. R. Manufacturing Co.	147
Ducommun Corporation	C–45
Eagle-Picher Lead Co., The	3
Eastman, H. John	C–47
Eastman Oil Well Survey Company of Texas	C–47
East Texas Refining Co.	D–10
Elliott Core Drilling Co.	C–13
Emsco Derrick & Equipment Co.	C–16
First National Bank in Dallas	D–21
First National Bank, Tulsa	163
Frick-Reid Supply Corp.	4
General Electric Co.	2
Gott, H. P., Manufacturing Co.	173
Guiberson Corporation, The	D–5
Gulf States Security Life Insurance Co.	D–14
Hazard Wire Rope Co.	155
Hercules Tool Co.	170
Hinderliter Tool Co.	156
Hughes Tool Co.	Back Cover
Hydrauger Corporation, Ltd.	173
Hydril Company	C–11
International Harvester Company of America	64
Jaggars-Chiles-Stovall, Inc.	159
Jones & Laughlin Steel Corporation	139
Jones, S. M., Co., The	167
Kobe, Inc.	C–14
Landis Machine Co., Inc.	1
Lane-Wells Co., The	C–38
Leschen, A., & Sons Rope Co.	8
Linde Air Products Co.	141
Lone Star Gas Co.	D–24
Lufkin Foundry & Machine Co.	131
Lufkin Rule Co.	173
Magnolia Petroleum Co.	D–24
Martin-Decker Corporation	C–28
Mepham, Geo. S., Corporation	151
Mercantile National Bank at Dallas	D–23
Merco-Nordstrom Valve Co.	Front Cover
Metric Metal Works	6
National Supply Companies, The	63
National Tube Co.	135
Oil Center Tool Co.	150
Oil Well Supply Co.	D–8–9
Oxweld Acetylene Co.	141
Pacific Oil Well Cementing Co., Ltd.	C–45
Patterson-Ballagh Corp.	C–23
Petroleum Rectifying Co.	C–27
Petroleum Securities Co.	C–49
Pittsburgh Equitable Meter Co.	Front Cover
Prest-O-Lite Company, Inc., The	141
Rector Well Equipment Co.	164
Reed Roller Bit Co.	56–57
Republic National Bank & Trust Co., Dallas	D–12
Republic Steel Corporation	59–60
Republic Supply Co. of California, The	C–40
Schley, Jack A.	D–22
Security Engineering Co.	C–19
Shaffer Tool Works	C–25
South Chester Tube Co.	71
Southern States Co., Inc., The	D–12
Southwestern Gas & Electric Co.	142
Sperry-Sun Well Surveying Co.	173
Sun Oil Company	D–23
Texas Electric Service Co.	132
Texas Power & Light Co.	D–26
Thermoid Rubber Co.	69
Tretolite Company	Inside Front Cover
Trimont Manufacturing Co.	55
Union Carbide & Carbon Corporation	141
Union Carbide Sales Co.	141
Union Wire Rope Corporation	145
U. S. Steel Corporation Subsidiaries	74, 135, 164 and D–8–9
Vernon Tool Co., Ltd.	C–49
Waukesha Motor Co.	153
Welded Tank & Steel Co.	D–22
Wickwire Spencer Steel Co.	128
Wyatt Metal & Boiler Works	D–2
Youngstown Sheet & Tube Co.	D–18